Journal of the Arkansas Academy of Science

Volume 11 Article 1

1958

Arkansas Academy of Science Proceedings - Volume 11 1958

Academy Editors

ARKANSAS ACADEMY OF SCIENCE

proceedings

VOLUME XI 1958

Correspondences should be addressed as follows:

Manuscripts:
William K. Noyce, Editor
University of Arkansas
Fayetteville

Subscriptions and Exchanges
L. F. Bailey, Secretary
University of Arkansas
Fayetteville

Price: Three Dollars

ARKANSAS ACADEMY OF SCIENCE

Founded 1917

proceedings

Volume XI 1958

TABLE OF CONTENTS

ARKANSAS ACADEMY OF SCIENCE

Forty-first Annual Meeting
University of Arkansas
Fayetteville, Arkansas
April 26-27, 1957

OFFICERS

President	J. W. Sears
President-Elect	J. R. Mundie
Secretary-Treasurer	L. F. Bailey

PROGRAM COMMITTEE

A. E. Harvey, L. J. Paulissen, Co-Chairmen
(Mrs.) E. P. Trapp, Entertainment and Meals
W. R. Orton, W. J. Richards, Housing
W. L. Evans, Junior Academy
R. S. Fairchild, Properties and Space
K. H. Stern, Publicity
L. F. Bailey, Science Fair

PROGRAM

Friday, April 26

8:30 a.m.	Registration.
10:00 a.m.	Psychology Section meeting jointly with Arkansas Psychological Association.
10:45 a.m.	First Business Meeting.
11:00 a.m.	Collegiate Section.
12:00 noon	Luncheon, Uark Bowl.
1:15 p.m.	General Meeting. The AAAS "Science Teaching Improvement Program," by Dr. I. A. Wallen, Assistant Director of the Program.
	Psychology Section Meeting.
2:15 p.m.	Sectional Meetings.
6:30 p.m.	Banquet, King Chicken. Address by Dr. Daniel Mazia, "Growth and Division of the Living Cell."
8:30 p.m.	Science Fair Exhibit, Men's Gymnasium.

ARKANSAS ACADEMY OF SCIENCE

Saturday, April 27

9:00 a.m. General Session with the Junior Academy. Selected papers from National Science Talent Search.

10:30 a.m. Second Business Meeting. Treasurer's Report. Reports of standing committees and special committees. Election of officers. Location of next year's meeting. New business.
Installation of Officers.
Adjournment by the new president.

11:30 a.m. Luncheon, Uark Bowl. Presentation of awards.

1:00 p.m. Botany Field Trip under the direction of Dr. Dwight M. Moore, to Martin's Bluff on White River.
Geology Field Trip under the direction of Dr. Kern Jackson and the Geology Department of the University of Arkansas, to Delaney on the White River.
Zoology Field Trip under the direction of Drs. Sealander, James, and Hoffman, to Devil's Den State Park: A combined bird-walk and cave exploration.

SECTIONAL PROGRAM

Biology and Agriculture

Chairman: J. L. Lancaster
University of Arkansas

Performance of Different Types of Insecticides in an Area Where Boll Weevil Resistance was Suspected. Jerry Ford, University of Arkansas

Trypetheliaceae in Arkansas. G. T. Johnson, University of Arkansas.

New Records for the Arkansas Flora. Dwight M. Moore, University of Arkansas.

The Effect of Systemic Insecticides on Growth and Fruiting of Cotton. Thomas F. Leigh, University of Arkansas.

The Epidermal Pore of Oxymitra Paleacea Bishoff, Eugene B. Wittlake, Arkansas State College.
Growth Regulating Substances in Extracts of Maple and Pear Flower Buds. Dewey L. Tackett and Lowell F. Bailey, University of Arkansas.
A Review of Oak Wilt Literature. Albert Robinson, Jr., Kansas Wesleyan University.

Chemistry

Chairman: W. K. Easley
East Tennessee State College

The Occurrence of Barium-140 in Nonirradiated Uranium Salts. H. R. Heydegger and P. K. Kuroda, University of Arkansas.
Some Research Problems in the Pulp and Paper Industry. K. G. Chesley, Director of Research, The Crossett Company, Crossett, Arkansas.
The Magnetic Field Effect Upon Azeotropic Distillation. W. D. Guthrie and E. S. Amis, University of Arkansas.
Physical Measurements on Catalysts and Their Significance. R. M. Engelbrecht, Research Department, Lion Oil Division, Monsanto Chemical Company, El Dorado, Arkansas.
Liesegang Rings and Diffusion in Inhomogeneous Media. K. H. Stern, University of Arkansas.
Polymers and Spinning Techniques of Interest in Forming Synthetic Fibers. J. Bruce Ballentine, Group Leader, The Chemstrand Corporation, Decatur, Alabama.
Some Characteristics of Amorphous Lead Azide. Brian S. Miller and Allen F. Robinette, Arkansas State Teachers College.

Geology

Chairman: Norman Williams
Arkansas Geological and Conservation Commission

Loess Deposits of Northwest Arkansas. James H. Quinn, University of Arkansas.
Stratigraphy of the pre-Atokan Carboniferous of the Arkansas Valley. Thomas J. Freeman, University of Arkansas.

Bloyd-Atoka Relationship in an Area of Northwest Arkansas. Burnal Ray Knox (Paper presented by Kern C. Jackson), University of Arkansas.
Geology of Township 12 North, Range 21 West, Johnson County, Arkansas. Charles G. Stone, University of Arkansas.

History and Political Science

Chairman: Gordon McNeil
University of Arkansas

The Library of a Revolutionary Leader, Antonio Nariño. Thomas Blossom, Southern State College.
English-Speaking Travellers in Brazil, 1851-1887. Charles G. Hamilton, College of the Ozarks.
The Role of the Intellectual in Politics. Terry Hoy, University of Arkansas.
The Oder-Neisse Line. Richard F. Staar, Harding College.

Physics

Chairman: R. H. Hughes
University of Arkansas
(Presiding Chairman: B. F. Stearns,
University of Arkansas)

A Continuation of Fractional Versus Multiple Loudness Studies. L. B. Ham, University of Arkansas.
A Direction Dependent Loudness Effect. Frank Biggs, University of Arkansas.
Measurement of Absorbed Ultraviolet Radiation Using a Thermistor Bridge. J. G. Dodd, Jr., Drury College.
The Crystalline Structure of Selected Azides. F. Kezer and J. Petz, University of Arkansas.
A Simple, Inexpensive Apparatus for the Demonstration and Measurement of Centrifugal Force. G. Lingelbach, University of Arkansas.
An Experiment with a Physics Problem Solving Service. Frank Biggs, Paul Sharrah, and B. F. Stearns, University of Arkansas.

ARKANSAS ACADEMY OF SCIENCE

Psychology
(Meeting jointly with the Arkansas Psychological Association)

Chairman: Frederick Schnadt
V. A. Hospital, North Little Rock

Business Meeting of Arkansas Psychological Association.

Panel Discussion: Activities and Policies, Board of Examiners in Psychology. Moderator, John Anderson, University of Arkansas.

Sensory Discriminations in Human Brain Damage. Robert C. Cannon, V. A. Hospital, North Little Rock.

The Relationship Between a Time Score and Anxiety Score on the Taylor Anxiety Scale. Donald H. Kausler and E. Philip Trapp, University of Arkansas.

Influence of Di-phenyl-barbituric Acid on the Convulsive Threshold and Learning Rate of Rats. Oddist D. Murphree, V.A. Hospital, North Little Rock and Lloyd D. Seager, University of Arkansas Medical School.

Panel Discussion: Training Needs for Psychologists in Arkansas. Moderator: H. Wilcoxon, University of Arkansas. Panel: Johan Eliot, State Board of Health, Little Rock; S. J. Fields, University Medical Center; Merton Schmolke, State Hospital, Little Rock; Fred Schnadt, V. A. Hospital, North Little Rock; J. V. West, Hendrix College, Conway; Wayne White, Superintendent of Schools, Fayetteville.

NEW RECORDS FOR THE ARKANSAS FLORA III

Dwight M. Moore
University of Arkansas

In the past few years, several species of plants which had not previously been reported for the Arkansas Flora have been found by the writer and some other students of this subject. Some of these species are entirely new to the State, and some are new county records. Except where otherwise noted these were found by the writer. Numbers in parentheses refer to literature cited.

PTERIDOPHYTA

1. Ophioglossum crotalophoroides Walt. the tiny Adder's Tongue Fern which had been previously reported from Nevada(4, 5) and Faulkner(8) Counties has since been found in Calhoun, Columbia, Hempstead, Little River, and Ouachita Counties.

GRAMINEAE

2. Bromus rigidus Roth was found in a good-sized colony around a refuse dump on the east side of a ridge about eight miles northwest of Conway in the southeastern corner of Conway County.

3. Eragrostis beyrichii J. G. Smith, which was previously known from only western Oklahoma, Texas, and Mexico, has been found on sandy ridges in Ouachita County near Chidester.

4. Triplasis purpurea (Walt.) Chapm., Purple Sandgrass, was also found in sand near Chidester.

AIZOACEAE

5. Trianthema Portulacastrum L., Sea Purslane, was found on the river side of the Mississippi levee at Helena, Phillips County, in July 1955, by the writer and Dr. Delzie Demaree.

PORTULACACEAE

6. Claytonia caroliniana Michx., reported in the manuals only as far west as Tennessee, was found

by the writer in company with Jesse Garrett Jorgensen, April 2, 1956, on the well-shaded north-facing cliff above the north fork of Cadron Creek, about twenty miles north of Conway in Faulkner County.

7. Claytonia virginiana f. rubusta (Somes) Palmer & Steyerm. has been found in Marion County in alluvial soil above the Buffalo River near the Arkansas Highway #14 ferry.

NYMPHACEAE

8. Cabomba caroliniana Gray, which had been reported only from Mississippi County, has been found in Union County, September 1941, and in Ouachita County in July 1953. This latter find was made by Mr. Carl Hunter who sent it in for identification.

CRUCIFERAE

9. Streptanthus maculatus Nutt. has long been on our list as occurring in several localities in the Ouachita region. Recent studies have shown that most of these should be designated as S. obtusifolius Hook. This is in addition to S. maculatus.

10. Streptanthus hyacinthoides Hook. was found in sandy soil at Bluff City, Nevada County, May 26, 1956.

11. Streptanthus squamiformis was described by Dr. George Goodman(2) from Oklahoma material, but he cited one specimen from Rich Mountain near Mena, Polk County, collected in May 1944 by Cooley.

SAXIFRAGACEAE

12. Saxifraga palmeri Bush. This species, described in 1928(1) is now known from ten Arkansas counties. Many of the specimens previously labelled "S. texana Buckl." are probably this species.

ROSACEAE

13. Neviusia alabamensis Gray. This species, previously considered an Alabama endemic, was found in southeast Conway County, April 1955.(7)

LEGUMINOSAE

14. Gleditsia x texana Sargent. This had previously been reported from the mouth of the Arkansas and White Rivers. It was found again in Lee County north east of Mariana in July 1955 by the writer with Delzie Demaree.

CISTACEAE

15. Helianthemum georgianum Chapm. This southeastern species was found on sandy ridges near Chidester, northwestern Ouachita County, in May, 1926.

ONAGRACEAE

16. Gaura filiformis Small, previously not on our lists, has been collected in seven east central counties by D. Demaree.

17. Jussiaea uruguayensis Camb. (J. grandiflora Michx.) was found in Saline County at the edge of the lake at Lakeside Country Club in September, 1948.

18. Oenothera heterophylla Spach. was found in large numbers on sandy ridges in Nevada County near Bluff City and in Ouachita County near Chidester, May 26, 1956.

19. Oenothera sessilis (Pennell) Munz.(9) This species described from a specimen collected near Little Rock by Dr. H. E. Haase in June 1885, is in the New York Botanical Garden herbarium with another from DeWitt, Arkansas County, collected by Demaree in May 1940. In the Gray Herbarium is one collected in Sebastian County by E. J. Palmer, May 24, 1931 with one from eastern Arkansas collected by F. L. Harvey in July 1880(?) as O. fruticosa.

CORNACEAE

20. Cornus alternifolia L.f., previously reported from only Stone County, has been found in the north end of Pope County north east of Nogo by the writer and Delzie Demaree in July 1955.

NEW RECORDS FOR THE ARKANSAS FLORA III

SCROPHULARIACEAE

21. Mimulus floribundus Dougl. This curious little yellow-flowered plant had been collected over a period of 15 years from beneath limestone ledges in four northwest counties, without having been successfully identified. It is a Rocky Mountain species with its nearest known station in Colorado and New Mexico. More about this will be published elsewhere.

22. Penstemon murrayanus Hook. This was sent in for identification by Mrs. Chester Clingan from Chidester, May, 1956. It is a beautiful scarlet species from Texas, and has become well established around Chidester.

CUCURBITACEAE

23. Cucurbita (Pepo) foetidissima HBK has been seen in Washington County along the Frisco tracks on the north side of Fayetteville, and in Franklyn County in a pasture about one mile north of Ozark.

COMPOSITAE

24. Carduus leptocephalus L. has been found well established along a small creek at Yardelle, Newton County, June 1955.

25. Coreopsis drummondii (D. Don) T. & G. has become abundantly established in the sandy ridges around Bluff City, Nevada County, and Chidester, Ouachita County, May 1956.

26. Hymenopappus corymbosus T. & G. was found at Chidester, Ouachita County, in May 1956. This is similar to, but definitely different from, H. scabiosaeus L'Her, which has been reported from several other stations in western and northwestern Arkansas.

From this account of new records from the neighborhood of Chidester, Ouachita County, it is forcibly indicated that much more study of this region is badly needed.

LITERATURE CITED

(1) Bush, B. F., 1928. Some species of Saxifraga, Amer. Midl. Nat. 11:220.

(2) Goodman, George J., 1956. A new species of Streptanthus, Rhodora 58:354-355.

(3) Moore, Dwight M., 1942. A check list of the grasses of Arkansas, Proc. Ark. Acad. Sci. 1:57-62.

(4) Moore, Dwight M., 1950. A new fern record for Arkansas, Proc. Ark. Acad. Sci. 3:33-4.

(5) Moore, Dwight M., 1951. Some new records for the Arkansas Flora, Proc. Ark. Acad. Sci. 4:61-63.

(6) Moore, Dwight M., 1952. Additional new records for the Arkansas Flora, II, Proc. Ark. Acad. Sci. 5:91-93.

(7) Moore, Dwight M., 1956. Neviusia Alabamensis in Arkansas, Rhodora 58:187-191.

(8) Moore, Jewel and Inez Hartsoe, 1955. A new location for Ophioglossum crotalophorodies in Arkansas, Proc. Ark. Acad. Sci. 7:63.

(9) Munz, P. A., 1937. Studies in Onagraceae X. The subgenus Kneiffia (genus Oenothera) and miscellaneous new species of Oenothera, Bul. Tor. Bot. Club, 64:291.

THE EPIDERMAL PORE OF *OXYMITRA PALEACEA* BISCHOFF

E. B. Wittlake
Arkansas State College

Epidermal pore development in *Oxymitra paleacea* is similar to pore development of species of liverworts in other families of the Hepaticae, with the exception of the *Riociaceae*. Pore development is morphologically inseparable from air chamber development.

In taxonomic works, reference is made to the "border" cells as to their number surrounding the pore, and their general character. It has been noted in Hirsh's 1910 study of air chamber formation in various *Riccias*, that there are two ways in which this comes about: one method is by actual filamentous growth of air chamber walls from a basement of colorless parenchymatous tissue, and the other is by a succession of internal cleavage divisions with separation of these cells schizogenously. The latter method was very apparent in *Oxymitra*.

Mature *Oxymitra* plants were selected from material in which the maturation of spores took place in the spring and the fall of the year. The usual histological procedures were followed in the preparation of permanent slides for study. Whole mounts were made of epidermal strippings for study of the mature pore.

Oxymitra paleacea has a pyramidal apical cell that cuts off segments laterally, the derivatives of which give rise to most of the tissues of the thallus. The beginning of air chamber development can be detected by the schizogenous separation of number four and number five epidermal derivatives lining the median groove, which in turn is parallel to the median longitudinal axis of the thallus. The apical cell lies at the bottom of this groove and derivatives contributing to air chamber formation differentiate in a vertical arc from it. The apical cell is usually very dense and evacuolate.

The schizogenous separation of derivatives proceeds toward the interior of the thallus and away from the median groove for a distance of two or three cells before the number four or five epider-

mal derivatives divide unequally. The small cell of this division is the initial cell contributing to the formation of the roof of the air chamber. The number of these initials is determined by the number of derivatives surrounding an intercellular space which widens and becomes the actual stoma of the pore.

Actual air chamber development begins then, by a splitting apart of the cells lining the median groove, and this schizogenous process proceeds with enlargement of surrounding cells, until the air chamber is from 5 to 16 cells in depth.

Air chamber development precedes pore development in Oxymitra. One might consider the development of the roof of the air chamber as a second phase, preceding the third phase of development resulting in the mature pore of the thallus. On the other hand, roof development is incidental to actual pore development, since from the standpoint of developmental morphology, there is actually an opening which is just as functional as the mature pore with its greatly thickened or modified cell walls. All cells of the roof of the air chamber actually contribute to the formation of the mature pore, either directly or indirectly. Another point substantiating this view is the position of the roof cells, consisting of radiating rows arranged in three very definite concentric rings or series of cells surrounding the mature pore.

If none of the initials of this unequal division of the fourth or fifth derivative have a subsequent oblique division, then the mature pore of the thallus will possess only 3 or 4 border cells, but this rarely happens. More often one of the original initials divides into two secondary initials. If all these cells divide obliquely, the mature pore will possess 6 - 8 border cells.

If they differentiate in a direction parallel to the median groove and close to the rim of this groove, enlargement is very slow and there is a very regular division of initials with fewer oblique divisions evident. Hence, pores in this area have fewer cells surrounding the mature pore. Pores found differentiating at a high rate in a wide lateral arc away from the apical cell, were found to have a larger number of border cells surrounding the pore. Therefore, some correlation exists be-

tween the rate of enlargement of the original derivatives from the apical cell and the occurrence of the number of oblique divisions that take place in the subsequent initials contributing to the formation of the air chamber roof. In other words, this process determines the number of radiating rows of cells in the roof of the air chamber and around the mature pore.

The first division of the primary apical cell is an unequal division, which results in the cutting off of the first intercallary cell, a much larger one than its companion cell. The initial functions as an apical cell in the same way that apical cells behave in cellular division of many filamentous algae; that is, once it divides, it is the inner daughter cell, toward the pore opening, that remains capable of further divisions. The second division of this initial gives rise to the second intercallary cell, the outermost one of which never divides again. Between each division an enlargement of the intercallary cells takes place, the rate depending on what direction from the apical cell of the thallus that they are differentiating.

The apical cell of a given row then divides again into daughter cells known as the third intercallary cell and a border cell. The pore now is bound by rows of cells, radiating out in all directions. The first intercallary cell becomes the mature epidermal cell of the mature wall of the air chamber. The second and third intercallary cells and the border cell form the actual roof of the mature air chamber. Very soon after the border cell is cut off, its radial walls become secondarily thickened as well as the portion of the wall next to the stoma.

In the early stages of secondary wall formation in the border cell, seen in cross section, the rim or lip develops at the apical angle of the cell.

Aside from pore development, ventral scale development did not proceed by the splitting of the middle lamella of the marginal cells in the colorless, parenchymatous tissue of the thallus, but they develop from an initial papilla which again behaves much like that of the apical cell of an algal filament.

CONCLUSIONS

1. Air chamber development is closely allied to pore development in Oxymitra paleacea: consideration of one cannot be separated from the other.

2. Air chamber development in O. paleacea is, by internal cleavage and a schizogenous process, similar to the second type, cited by Sealey 1930 in referring to Hirsh's work, 1910.

3. There is some correlation of the number of ultimate border cells around the opening of the mature pore, depending upon the direction of differentiation from the apical cell with the rate of differentiation.

4. Pore development in O. paleacea is not of the simple type found in some species of Riccia, but definitely of a type more similar to pore development in other genera in the Marchantiales.

5. The number of border cells surrounding the mature pore opening falls within the range of 4 to 8, the most constant number being 5 or 6.

6. The beginning of air chamber development, which likewise marks the beginning of pore development, starts at a point removed from the apical cell by 13 to 15 cells. In microna, the actual vertical distance from the apical cell varied from 180 to 220 microns.

LITERATURE CITED

(1) Campbell, D. H., 1918. The Structure and development of Mosses and Ferns. 3rd Ed. New York.

(2) Hirsh, P. E., 1910. The Development of Air Chambers in Ricciaceae. Bull. Torr. Bot. Club 37:73.

(3) Howe, M. A., 1914. Further observations on the Texas Oxymitra (Tessalina). The Bryologist 17:92-94.

(4) Leitgeb, H., 1879. Untersuchungen uber die Lebermoose 4:34-45, Pls. 3, 4.

(5) Sealey, J. O., 1930. The Morphology of Oxymitra Androgyna. Amer. Jour. Bot. 17:19-29.

GROWTH REGULATING SUBSTANCES IN EXTRACTS OF MAPLE AND PEAR FLOWER BUDS

Dewey L. Tackett and Lowell F. Bailey
University of Arkansas

In recent years several investigators have suggested that growth inhibitors may be responsible for dormancy in plants. Evanari(4) has called attention to the wide distribution of growth inhibitors in various plant parts, and Stewart and Caplin(13) have reported inhibiting substances in maple buds, potato tubers, and onion bulbs. Hemberg(7,8) proposed that growth inhibitors in potato tubers and Fraxinus buds are directly involved with dormancy, since these substances disappeared when dormancy was broken either naturally or artificially. Hendershott and Bailey(9) extracted a substance from peach flower buds which inhibited the elongation of pea epicotyl sections. However, the amount of inhibitor did not decrease as the end of the dormant period approached; in fact, the level of inhibition did not decrease when the buds had opened and flowers were evident. A later report identified this substance as a cyanide compound(10). In the present study, dormant maple and pear flower buds have been shown to contain a substance which inhibits the elongation of etiolated pea epicotyl sections and does not give a test for cyanide. Paper chromatography has been used to separate naturally-occurring growth regulators in bud extracts.

Dormant buds of Acer saccharum Marsh, and Pyrus communis L. var. E. J. Taylor were extracted at 1°C. for twenty hours with three changes of anhydrous ethyl ether. The combined ether extracts were evaporated to dryness and the residue stored at 5°C. in a dessicator over calcium chloride. The pea straight growth test was used to detect growth effects of substances obtained from buds. Pea seedlings were grown in white sand in a darkroom maintained at 25°C. and 80% relative humidity. A section was cut just below the plumule of an epicotyl when the third internode was two to five cm. long. Cutting was done in weak red light, using a tool consisting of two razor blades spaced 4.4 ± 0.2 mm. apart. Sections were randomly distributed in

experimental solutions.

The standard solution used in growth tests contained 1.0 p.p.m. 3-indoleacetic acid (IAA), 2.0% sucrose, and 0.05 M. phosphate buffer at pH 5.7. The experimental solutions contained, in addition, a measured quantity of bud extract or a zone cut from a paper chromatogram of a bud extract. Ten pea sections were used with each test solution and after twenty hours in a darkroom growth was measured by using a photographic enlarger which magnified ten times.

Growth Tests. Growth tests were made in Petri dishes containing a filter paper disc and five ml. of test solution. Bud extracts were suspended in five ml. of distilled water and filtered before addition to the standard solution at rates of 0.5, 1.0, and 2.0 ml. The results of typical tests using maple buds collected February 6, 1957 and pear buds collected February 2, 1957 are summarized in Table I. These tests demonstrate the amount of growth inhibition of pea sections obtained with maple and pear bud extracts.

Chromatography and Growth Tests. Bud extracts were fractionated by means of ascending paper chromatography using 16 x 2½-inch strips of unwashed Whatman #1 filter paper. Good separation was obtained with 80% isopropanol as the developing solvent. A mixture of water, ethanol, butanol, and isopentanol (4:2½:1:1) also gave satisfactory results. Ether extracts were redissolved in ether with one ml. of water added. The ether was evaporated and the water extract was streaked across one end of a paper strip and allowed to dry. As a standard practice the development was carried out in the darkroom and strips were equilibrated for at least four hours prior to lowering into the solvent.

Growth tests were conducted in small covered dishes containing zones cut from a chromatogram, two ml. of the standard solution, and ten pea epicotyl sections. Results of a typical test using an extract of dormant maple flower buds chromatographed in 80% isopropanol are presented in Figure 1.

The inhibition zones cover a wide range of R_fs, but those statistically significant are found only between R_fs 0.50 and 0.80. An improved separation

TABLE I

EFFECT OF MAPLE AND PEAR FLOWER BUD EXTRACTS ON GROWTH OF PEA SECTIONS, IN MILLIMETERS AND PERCENT

Plant	Ml. of extract added			
	0.0	0.5	1.0	2.0
Maple (400 buds/ml.)	6.92 ± 0.13* 100.0%	5.80 ± 0.03 56.6%	5.72 ± 0.04 52.5%	5.29 ± 0.04 35.3%
Pear (160 buds/ml.)	8.31 ± 0.01 100.0%	7.33 ± 0.09 75.0%	7.18 ± 0.09 71.1%	6.93 ± 0.09 64.8%

*Standard error of the mean.

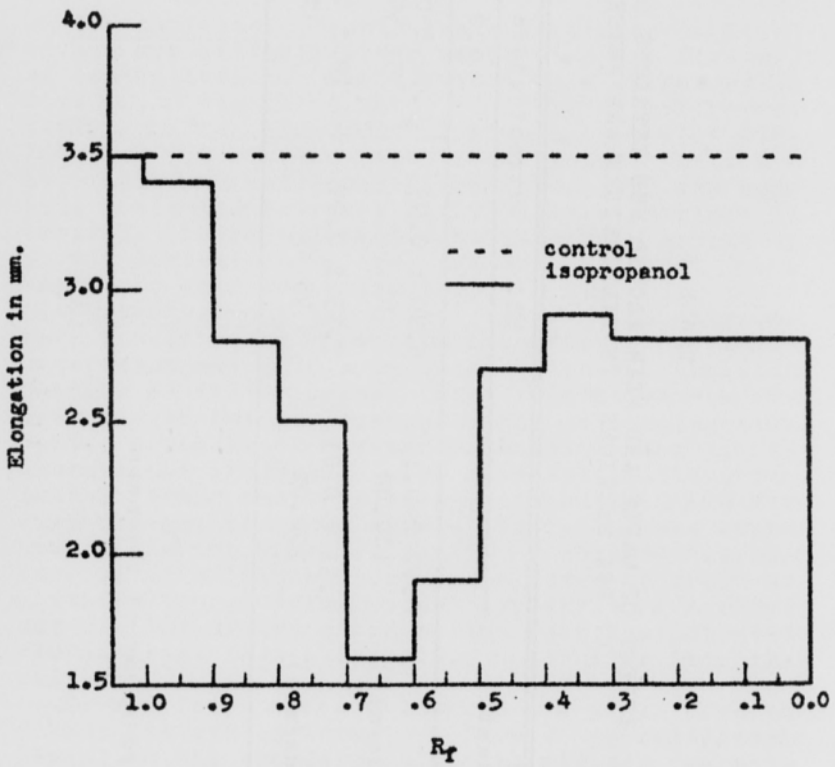


Figure 1. Results of a growth test using a chromatogram of an extract of dormant maple flower buds developed in 80% isopropanol.

was obtained by eluting these zones overnight with water at 5°C., evaporating the eluate to dryness over steam, and rechromatographing in the alcohol mixture. Growth tests with zones cut from these chromatograms demonstrated that inhibiting substances had completely masked the presence of a growth-promoting substance, as shown in Figure 2. Compounds fluorescing in ultraviolet light were located at the higher R_fs and these zones were used for separate growth tests.

Results of growth tests using six chromatograms prepared by two-step chromatography are presented in Table II. Two features are noteworthy: A growth-promotion zone most prominent at R_f 0.97, and a growth-inhibition zone between R_fs 0.60 and 0.80. No significant activity was recorded below R_f 0.50.

CHARACTERIZATION OF THE GROWTH-ACTIVE SUBSTANCES

Growth Promotion Zone. The zone above R_f 0.97 fluoresced pink under ultra-violet light, gave an acid reaction when streaked with a universal indicator, and an ash color when sprayed with Salkowski reagent(11). The zone just beneath fluoresced light purple, gave no acid reaction, and gave a faint pink color with Salkowski reagent. Synthetic IAA chromatographed with the alcohol mixture gave a pinkish fluorescence in ultra-violet and was acidic at R_f 0.97. Apparently the growth-promotion obtained at R_f 0.97 was a response to IAA in the bud extract.

The same growth-promoting zone was evident in chromatograms of non-dormant buds, with the growth response being more pronounced. Apparently, the level of active IAA increases as buds pass from the dormant to the non-dormant state, as reported previously(6).

Growth Inhibition Zone. Salkowski tests and examination in ultra-violet light failed to give any suggestion of an auxin type of compound in the zone of inhibition. Tests for cyanide were made after hydrolysis with sodium hydroxide and the addition of ferric chloride, by adding hydrochloric acid and ferrous sulfate. The presence of cyanide in this test is indicated by the formation of prus-

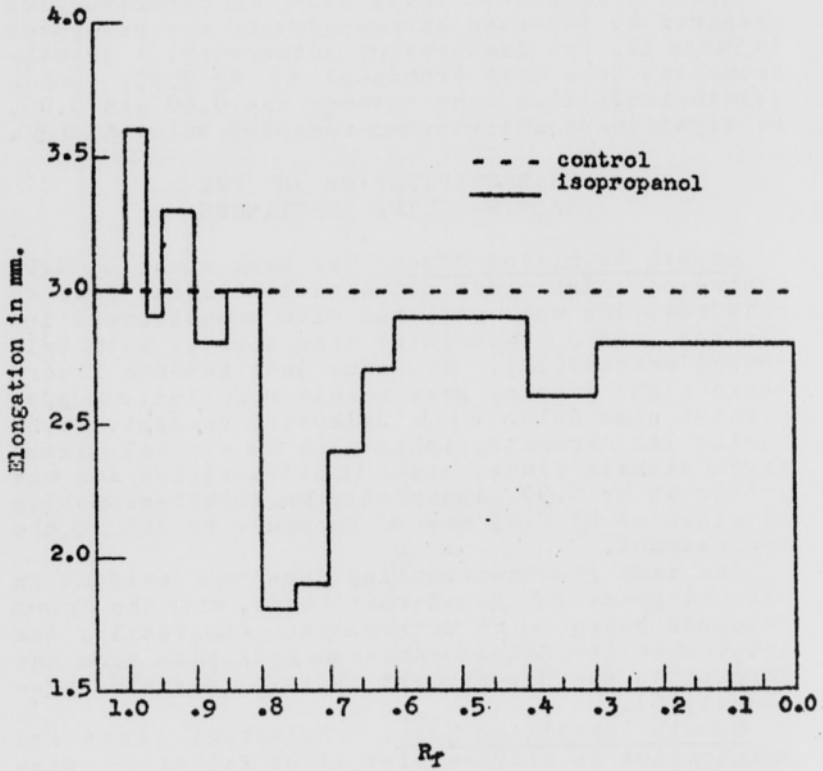


Figure 2. Growth test results with an extract of dormant maple flower buds using a two-step chromatographic process. The inhibition zone, between F_{rs} 0.50 0.80, of the 80% isopropanol chromatogram was rechromatographed in the alcohol mixture.

TABLE II

GROWTH TEST RESULTS OF SIX CHROMATOGRAMS OF 100-150 DORMANT AND NON-DORMANT MAPLE FLOWER BUDS DEVELOPED IN THE ALCOHOL MIXTURE AFTER A PRELIMINARY CHROMATOGRAPHING IN 80% ISOPROPANOL

Test	R_f .50	.60	.65	.70	.75	.80	.85	.90	.95	.97
Dormant buds										
#1		I*	I	I	I			P*	P	P
2		I	I	I	I					P
3		I	I	I	I	I	I			
4	I	I	I	I	I			P	P	P
Non-dormant buds										
#4		I		I	I	I			P	
6					I		P			P

*I -- Inhibition; P -- Promotion. Results significant at the one per cent level.

sian blue. No evidence of cyanide compounds was obtained with eluates of the inhibition zones.

Elliott and Leopold(2) proposed that dormancy in oats may be due to inhibitors that antagonize sulfhydryl-containing enzymes. An -SH compound could competitively inhibit a sulfhydryl enzyme necessary for growth. When a drop of iodine-azide solution(5) was applied to the chromatograms in the zones of inhibition, the deep brown color of the solution quickly disappeared. This is a specific reaction for thicketones (R=S) and thiols (R-SH). Zones on chromatograms that indicated the presence of thicketones and/or thiols are given in Table III, as are those that gave evidence of being acid.

With dormant buds, zones showing growth inhibition gave a positive test for divalent sulfur compounds. Also, there was a close correlation between the presence of sulfur and acidic substances, suggesting that thiols rather than thicketones were involved. This was substantiated by the failure of the zone of inhibition to catalyze the iodine-azide reaction after mild oxidation with hydrogen peroxide. Apparently, a thiol compound occurs in the zone of inhibition.

The close correlation between inhibition and the presence of thiol compounds in dormant buds was not evident with non-dormant buds (Table III). The level of inhibition in non-dormant buds dropped, but there was no corresponding loss in thiols. Similar solubility properties and R_f values indicate that the thiol compound in both dormant and non-dormant buds may be glutathione. Glutathione is soluble in water and insoluble in ether, occurred between R_fs 0.58 and 0.65 when chromatographed in the alcohol mixture, and catalyzed the iodine-azide reaction.

DISCUSSION

Considerable evidence exists which indicates that dormancy in buds results from the presence of substances specific for growth inhibition. The earlier suggestion that auxins at relatively high concentrations cause dormancy has been discredited by several investigators(12). Chan-Thom(1) showed that auxin concentrations necessary for inhibition never occurred in dormant pear buds. Hemberg (7,8)

TABLE III

CHROMATOGRAPHIC SPECTRUM OF EXTRACTS OF DORMANT AND NON-DORMANT MAPLE FLOWER BUDS FOR ACIDITY AND IODINE-AZIDE TESTS. RESULTS ARE FOR SIX CHROMATOGRAMS DEVELOPED IN THE ALCOHOL MIXTURE WITH A PREVIOUS CHROMATOGRAPHING IN 80% ISOPROPANOL

	Dormant						Non-Dormant			
Test No.	Acidity				Iodine-azide		Acidity		Iodine-azide	
	1	2	3	4	3	4	5	6	5	6
R_f										
0.97	x	x	x	x			x	x		
.95							x		x	
.90							x		x	
.85					x		x	x	x	x
.80					x		x	x	x	x
.75	x	x	x	x	x	x	x	x	x	x
.70	x	x	x	x	x	x	x	x	x	x
.65	x	x	x	x	x	x	x	x	x	x
.60	x	x	x	x	x	x	x	x	x	x
.55			x	x		x		x		x
.50						x		x		x

found a connection between inhibitors and dormancy in potato and Fraxinus buds and established that the auxin content does not change either during dormancy or immediately thereafter. According to Leopold(11) dormancy results from the occurrence of acidic inhibitors in buds. In the presence of these inhibitors endogenous auxin is ineffective. The onset of bud development is accompanied with the loss of growth inhibitors and the production of glutathione.

In this study, dormant flower buds of maple are shown to contain substances that promote and inhibit elongation of pea epicotyl sections. The growth-promoting substance apparently is 3-indoleacetic acid which increases in growth activity as dormancy is lost. The growth-inhibiting substance is not a cyanide-containing compound. On paper chromatograms growth inhibition is associated with an acidic zone of one or more compounds which contain thiol groups. As dormancy passes, inhibition in this zone disappears but the sulfhydryl reaction remains and extends over a wider zone on the chromatograms.

The persistence of the sulfhydryl reaction in chromatograms of non-dormant buds suggests that the thiol detected in dormant buds may not be related directly to the inhibitor. This thiol may be glutathione since these compounds give similar R_f values when chromatographed in the same manner and possess similar solubility properties. Glutathione increase has been reported as dormancy is lost(3) and this could account for the broad sulfhydryl zone on the chromatograms.

The possibility exists that the thiol present in dormant buds is not glutathione but a specific substance responsible for dormancy -- acting as a growth inhibitor by competitive interference with physiological activity of intracellular SH-groups. Since the two compounds chromatograph similarly, the proposed thiol inhibitor could be structurally similar to glutathione and serve as a precursor for this compound.

SUMMARY

Ether extracts of dormant flower buds of maple and pear contain one or more substances which in-

hibit the elongation of etiolated pea epicotyl sections. Paper chromatograms of bud extracts contained a growth-promoting substance, probably IAA, and a growth-inhibiting zone. The latter was acidic, contained no cyanide, and gave a reaction characteristic of thiols. As dormancy passed, inhibition disappeared but the sulfhydryl reaction remained. Glutathione may be involved in the sulfhydryl reaction, although the thiol occurring during dormancy may not be identical with that occurring after dormancy ends.

LITERATURE CITED

(1) Chan-Thom, L. A., 1951. A study of the respiration of hardy pear buds in relation to rest period. Doctoral thesis, Univ. of Calif., Berkeley. (Cited in reference 12.)

(2) Elliott, B. B. and A. C. Leopold, 1953. An inhibitor of germination and of amylase activity in oat seeds. Physiol. Plantarum 6: 66-78.

(3) Emilsson, B., 1949. Studies on the rest period and dormant period in the potato tuber. Acta. Agri. Sueo. 3:189. (Cited in reference 11.)

(4) Evanari, M., 1949. Germination inhibitors. Bot. Rev. 15:153-194.

(5) Feigl, F., 1954. Spot Tests. Organic Applications. Vol. II. Elsevier Publishing Co., Amsterdam.

(6) Hemberg, T., 1947. Studies of auxins and growth-inhibiting substances in the potato tuber and their significance with regard to its rest period. Acta. Hort. Berg. 14:133.

(7) _____, 1949. Significance of growth-inhibiting substances and auxins for the rest-period of the potato tuber. Physiol. Plantarum 2: 24-36.

(8) _____, 1949. Growth-inhibiting substances in terminal buds of Fraxinus. Physiol. Plantarum 2:37-44.

(9) Hendershott, C. H. and L. F. Bailey, 1955. Growth inhibiting substances in extracts of dormant flower buds of peach. Proc. Amer. Soc. Hort. Sci. 65: 85-92.

(10) Jones, M. B., J. W. Fleming and L. F. Bailey, 1957. Cyanide as a growth-inhibiting substance in extracts of peach leaves, bark, and flower buds. Proc. Amer. Soc. Hort. Sci. 69:152-157.

(11) Leopold, A. C., 1955. Auxins and Plant Growth. Univ. of Calif. Press, Berkeley.

(12) Samish, R. M., 1954. Dormancy in woody plants. Ann. Rev. Plant Physiol. 5:183-204.

(13) Steward, F. C. and S. M. Caplin, 1952. Investigations of growth and metabolism of plant cells, III. Evidence for growth inhibitors in certain mature tissues. Annals Bot. 16:477-489.

SOME PHYSICAL MEASUREMENTS ON CATALYSTS AND THEIR SIGNIFICANCE

R. M. Engelbrecht
Monsanto Chemical Company

The large scale use of catalysts in commercial processes has undergone remarkable expansion the past decade. Along with this the manufacture of catalysts has become a major industrial activity. It is conceded that knowledge of the surface chemistry of catalytic processes is of critical importance and considerable effort is being extended in this direction. However, knowledge of the catalyst's physical structure is essential for a complete understanding of catalyst function.

Measurements to determine the physical structure of catalysts are significant in that catalyst deterioration on use and regeneration may be followed, the effect of process variables on catalysts may be determined, and the relative importance of various factors in catalyst preparation and treatment may be determined. In addition to this the economics of a process often hinge on the catalyst or catalyst life.

It is the purpose of this paper to describe some methods used for the determination of surface area and pore volume. These two physical properties of catalysts are extremely valuable in the determination of an optimum catalyst as a criteria for the reproducible production of catalysts, informing a basis for comparison of catalysts, etc.

The Brunauer, Emmett, Teller (B.E.T.) method (1) is considered the most accurate for surface area and pore volume measurements. This is essentially a low temperature-high vacuum method that entails covering the catalyst with a single layer of gas molecules, calculating the molecules necessary to accomplish this, and determining the surface area from known physical constants of the gas used. Nitrogen is the gas most generally used and the temperature of adsorption is -196°C. Pore volume is also determined by this method; it is calculated from desorption data. B.E.T. nitrogen adsorption-desorption requires rather elaborate apparatus and is very time consuming. About two days

is required for a surface area measurement and a week is required for pore volume measurements. The methods described below circumvent these disadvantages.

AROMATIC ADSORBANCY INDEX METHOD (4,5)
SURFACE AREA DETERMINATION.

I. REAGENTS AND APPARATUS

Aromatic Adsorbancy Index Solution. This is a 30% (by volume) toluene and 70% (by volume) iso-octane solution. These chemicals should be reagent grade and water free.

Adsorbancy Vessel. Figure 1 shows a diagram of this vessel. A series of those were made from 50 ml. distilling flasks. A two-way stopcock is attached to the delivery arm of the flasks. The annular space between the ground glass socket insert and the walls of the flask is 1/16". The end of this insert should not extend below the neck of the flask. These restrictions are essential to efficient cleaning of the adsorbancy vessel. A ground-glass ball joint stopper to fit the socket is also needed.

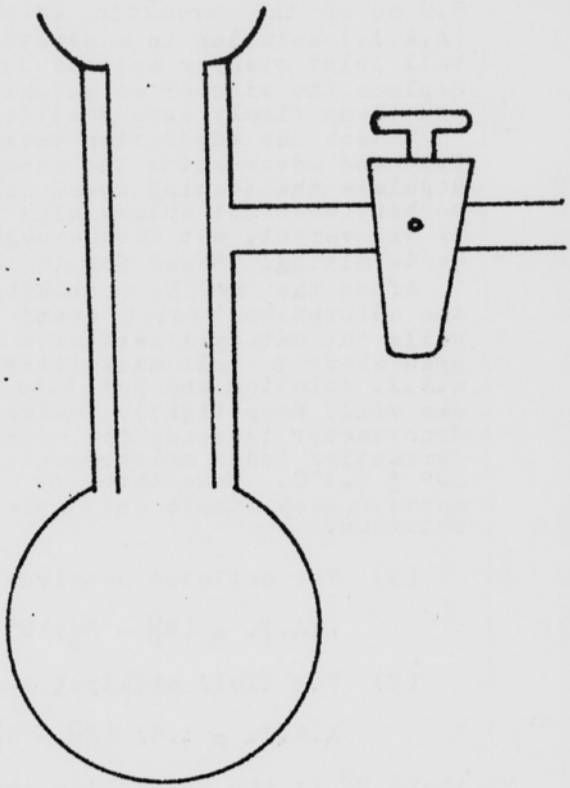
Refractometer. All refractive index measurements are made at 20° ± 0.1°C and are read to the fourth decimal place.

Automatic shaking device.

II. PROCEDURE

Dry the catalyst, whether pelleted or fluidized, in a muffle oven overnight. The drying temperature is dictated by the catalyst reaction temperature. Cool in a desiccator.

Weigh a clean, dry adsorption vessel on an analytical balance. For a pelleted catalyst weigh 3.50 ± 0.01 grams of the dried catalyst into the vessel; for a fluidized catalyst weigh 2.50 ± 0.01 grams. Clamp a greased, ball joint stopper on to the vessel and evacuate through the stopcock with a vacuum pump for ten minutes. All effort must be made to minimize contact time of the



AROMATIC ADSORBANCY INDEX

REACTION VESSEL

FIGURE 1

catalyst sample with the atmosphere.

Open the stopcock of the adsorption vessel briefly to reduce the vacuum and facilitate removal of the ball joint stopper. With 5.0 cc of the aromatic adsorbancy index (A.A.I.) solution in a pipette, remove the ball joint stopper and add the adsorbent. Replace the stopper as quickly as possible and clamp firmly into position.

Attach the adsorption vessel with catalyst and adsorbent to the automatic shaker. Regulate the shaking speed so that the adsorbent does not splash high into the neck of the vessel, but fast enough to give adequate mixing. Shake for two hours.

After the two hour shaking period, let the adsorption vessel stand five minutes while the catalyst particles settle. Withdraw about a half milliliter of the clear A.A.I. solution and put into a small screw cap vial. Keep tightly sealed until the refractometer is ready for measurement. All refractive index measurements are made at $20^{o} \pm 0.1^{o}C$. Make three or four measurements on each sample and on the A.A.I. stock solution.

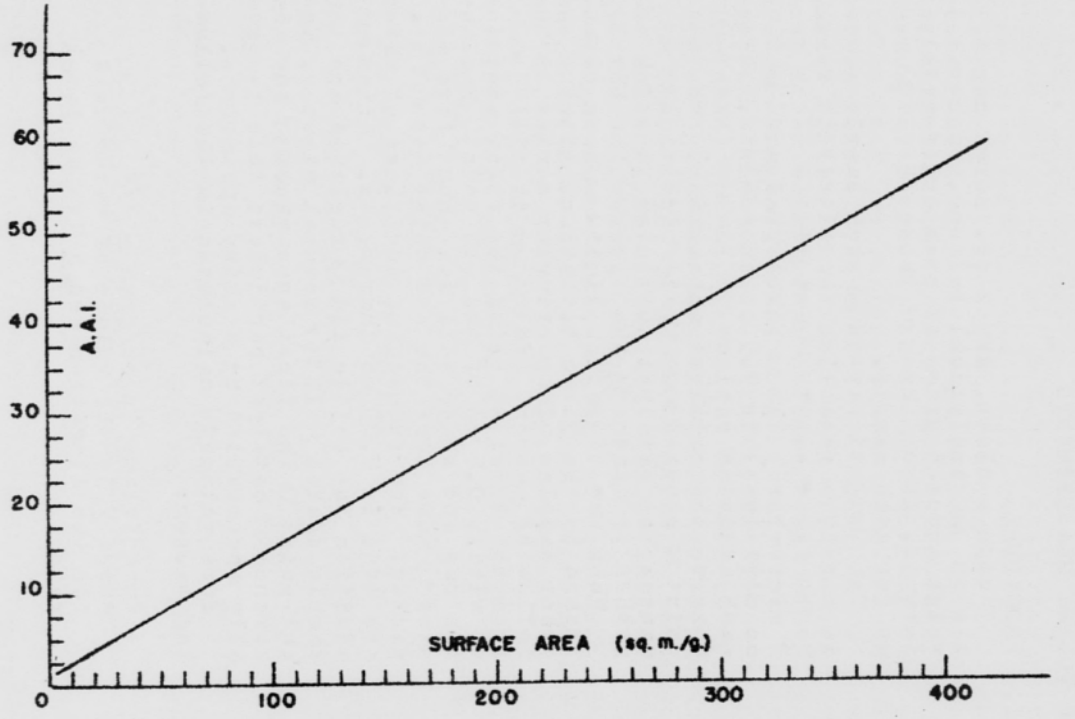
(1) For pelleted catalyst samples:

$$A.A.I. = (N_D^0 - N_D^1)10^4$$

(2) For fluid catalyst samples:

$$A.A.I. = 1.41\ (N_D^0 - N_D^1)10^4 - 1.1$$

where N_D^0 is the refractive index of 20°C of the A.A.I. stock solution; N_D^1 is the refractive index at 20°C after adsorption; (1.41) and (1.1) are correction factors for the change in sample size. The surface area in sq. m./gram is obtained from the calculated A.A.I. value by reference to the calibration curve, Figure 2.



AROMATIC ADSORBANCY INDEX (A.A.I.) vs. SURFACE AREA

FIGURE 2

WATER TITRATION METHOD (3)
PORE VOLUME MEASUREMENTS

I. PROCEDURE.

Weigh a clean, dry 2 oz. screw cap bottle on an analytical balance. Accurately weigh about 5 grams of oven dried catalyst into it. About three of these should be made up for each sample.

The first titration on each sample series is merely to establish the titration range. To the first sample add distilled water from a micro-buret (10 cc buret graduated in 0.02 cc divisions) in 0.5 cc increments. After each addition replace the lid and shake well. Observe the catalyst appearance. The end-point is reached when the last addition of water causes the catalyst particles to stick together or adhere to the sides of the bottle.

When the titration limit has been established by the first titration, titrate the other samples of a particular series in the following manner. Add enough distilled water from the buret to bring the first addition to within 0.5 cc of the end point. Replace the cap and shake well for about five minutes to make sure the end point has not been passed. The succeeding additions of water are made in 0.05 cc increments. After each addition the bottle lid is replaced and the sample shaken well for several minutes. The end-point is the first appearance of any adherence of catalyst particles; this is usually accompanied by a shiny appearance.

Pore volume is calculated in the following manner:

Pore Volume in cc/gram = V/W
where V is the volume of water used for the titration and W is the sample weight.

DISCUSSION

The Harshaw Chemical Company submitted four catalyst samples for evaluation together with their B.E.T. data for surface area and pore volume. The

reliability of the methods described herein has been based on the comparative data given in Table I.

From Table I it may be seen that the comparative data of the A.A.I. and B.E.T. methods for surface area is very good. The A.A.I. values are within ± 5 sq.m./g. of the B.E.T. values. The four catalyst samples of this table include both pelleted and fluidized catalysts. The reproducibility of the A.A.I. method is shown in Table II; the precision is ± 5 sq.m./gram. Total time for an analysis by the A.A.I. method is about three hours; actual working time about an hour. Another advantage of this method is that a group of samples may be done simultaneously whereas only one (requiring about eight hours) may be done at a time with the B.E.T. method. The A.A.I. method is dependent on refractive index measurements; accuracy of these measurementments to ± 0.0002 units is mandatory. The calibration curve for this method, Figure 2, was taken from the Kellogg paper(5).

Comparative values of the water titration and B.E.T. methods for pore volume determination are also given in Table I. The water titration values are within ± 0.06 cc/gram of the B.E.T. values. The excellent reproducibility of the water titration method is shown in Table III. The precision is well within ± 0.01 cc/gram. Herein lies the value of the method. Although the values will not be equivalent to B.E.T. values, with the excellent precision of the water titration method trends in pore volume change can easily be followed. Analysis time by this method is about an hour compared to a week by the B.E.T. nitrogen adsorption-desorption method.

In Table I comparative values are also given for a carbon tetrachloride-cetane method (2) of pore volume measurement. The data are not in good agreement with the B.E.T. values. The method was not considered satisfactory for pore volume measurements.

The main advantage of the A.A.I. method and water titration method is the time required for analysis. Both methods greatly reduce analysis time and have the additional advantage that a number of samples may be determined simultaneously. The distinct advantage of the B.E.T. method is that, from the data

TABLE I

COMPARISON OF METHODS

Harshaw Catalyst Sample	Pore Volume (c.c./g.) B.E.T.	Water Titration	CCl_4-Cetane	Surface Area (sq.m./g.) B.E.T.	A.A.I.
1	0.30	0.39	0.08	14.3	14
2	0.45	0.40	0.40	160	165
3	0.37	0.33	0.22	61	56
4	0.42	0.35	0.30	150	147

TABLE II

REPRODUCIBILITY OF A.A.I. METHOD*

I	II	III	IV	V
200	94	179	14	300
200	94	164	14	330
200	94	164	14	
200	94	164		
		164		
		156		

*Values are surface area in sq.m./gram.

TABLE III

REPRODUCIBILITY OF WATER TITRATION METHOD*

I	II	III	IV
0.419	0.391	0.468	0.325
0.417	0.389	0.467	0.326
0.417		0.463	
0.416		0.461	
0.417		0.455	
0.414		0.456	
0.418			
0.418			
0.415			
0.416			
0.419			

required for surface area and pore volume, pore size distribution calculations can be made. Measurements of this type are also valuable in catalyst evaluation.

LITERATURE CITED

(1) Advances in Catalysis. 1952. Vol. IV, pp. 88-147. Academic Press Inc., New York.
(2) Benesi, H. A., Bonnar, R. U., and Lee, C. F. 1955. Anal. Chem., 27:1963.
(3) Innes, W. B. 1956. Oil and Gas Jour. 54:162-64, #80.
(4) Rescorla, A. R., Ottenweller, J. H., and Freeman, R. S. 1948. Anal. Chem., 20:196-200.
(5) M. W. Kellor Co., New York Div. of Refining. 1947. 27, III, 38-47.

ACKNOWLEDGEMENT

The author wishes to express appreciation to the Harshaw Chemical Company for their cooperation in supplying catalyst samples and B.E.T. data.

*Values are pore volume in cc/gram.

PLATEAU SURFACES OF THE OZARKS*

James Harrison Quinn
University of Arkansas

The Salem, Springfield, and Boston Mountain plateaus(2) form three step-like surfaces of the Ozark highland in Northwest Arkansas, occupying a belt 65 miles wide, and extending from the Oklahoma border eastward across the highland.

The lowest and northernmost of the surfaces, the Salem Plateau, stands at an elevation of about 250 feet on the east, rises to 1,250 feet on the west, and has been intricately dissected. The Salem Plateau is bordered on the south by the Eureka Springs escarpment with a maximum height of 400 feet.

To the south of the Eureka Springs escarpment is the Springfield Plateau which stands from 1,000 to 1,500 feet above sea level. Erosion remnants on the surface stand 250 to 500 feet higher, but the Boat Mountain group rises to 2,250 feet -- about 750 feet above the level of the plateau.

The north edge of the Springfield Plateau is dissected by headward erosion of streams. The south border has numerous buttes and spurs. Large areas of the plateau are gently undulating. In most places the relief is less than 100 feet.

Valleys on the plateau are broad and shallow. Formerly, some were deeper, but the old channels have been filled with locally derived gravel. These valleys change to sharply incised, V-shaped gulleys near the escarpments.

The Springfield Plateau is separated from the Boston Mountain Plateau to the south by the Boston Mountain Escarpment, which has a maximum height of 800 feet.

The Boston Mountain Plateau is nearly destroyed, but the mountains are still flat-topped, and in a few places are surmounted by erosion remnants which

---

*Presented before the Geology Section of the Arkansas Academy of Science at the Fortieth Annual Meeting, April 20, 1956.

rise a few hundred feet higher.

The trunk streams of the area are the White and Illinois Rivers. The White flows north and east, thence southeast to the Arkansas. The Illinois flows west to the Arkansas in Oklahoma. The divide near Springdale, Arkansas is only about 3 miles wide. Both streams are remarkably sinuous; their tributaries are equally straight and short.

The soil profiles of all three surfaces are similar in their stage of development. They are also difficult to evaluate because all are capped with a few inches to a few feet of virgin or reworked loess, depending on their topography.

In the V-shaped tributary valleys there is little or no expression of a soil profile and no loess.

Some fossil mammal remains have been recovered from the plateaus. One of these is a tooth of Onager fraternus, slightly waterworn and presumably from gravel, recovered from a well near Bentonville. Another is a tooth of Mammut americanum found in the bed of Osage Creek, in Benton County T. 18 N., R. 32 W., S. 35, by Mr. R. R. Guthary. The Onager tooth belongs to a much earlier episode of deposition than does the mastodon tooth. Onager fraternus is known in North America from Sangamon and younger deposits. The tooth does not release a "burned bone" odor on ignition. The mastodon tooth releases the odor and is of post-Wisconsin age.

Near the foot of the escarpment in a number of places on the Springfield Plateau there are rock-cut sloping surfaces covered with a veneer of gravel. Fragments are large and angular nearest the escarpments, but diminish in size and become round farther away. The gravel veneer is covered with a layer 2-4 feet thick of fine material, chiefly reworked loess. These surfaces represent pediments still retaining their layers of pediment veneer.

The surfaces have been considered peneplanes or partial peneplanes by earlier workers. At the turn of the century Purdue,(8) following the fashion of the time, attributed the plateau surfaces to peneplanation and believed that they represented a single episode and had subsequently been divided by faulting. Hershey(4) argued for two episodes of peneplanation and considered the Boston Mountain surface as Cretaceous in age. Subsequent writers have followed the assumption of these authors that

the surfaces are the product of peneplanation. All have followed the Davisian concept of land form development. Davis(3) recognized a difference between the development of land forms under arid and humid conditions and recognized the fact that climates are subject to change (ibid. p. 298). Davis also recognized (ibid. p. 331) that glacial periods probably correspond with times of more moist climate. In his later works Davis discounted the effects of Pleistocene climates and thought that climatic changes (beyond these ephemeral accidents) is a product of the slow wearing away of mountain ranges. In other words he thought that climate changes are geared to the erosion cycle. Otherwise his concept of youth, maturity and old age would be inapplicable.

Actually there is no evidence in the Ozark region to support the concept of peneplanation. There is abundant evidence to support the concept of pediplanation, as the process which has produced the plateau surfaces.

The escarpments separating the surfaces are very irregular. Spurs and isolated erosion remnants occupy divides between streams. The isolated remnants are steep sided, but do not differ lithologically from the strata which once encompassed them. They are, in fact, buttes, not monadnocks. The broad shallow valleys of the plateaus, the pediment-like surfaces at the foot of escarpments, and gravel deposits on the surfaces are products of land form development under arid conditions. The V-shaped valleys trenching the edges of the escarpments necessarily were out under a different and more humid set of conditions.

The most compelling evidence for pediplanation is indicated by the similar soil profiles of the surfaces. They are all equally immature, in depth of development and depth of weathering of bed rock. This must mean that these surfaces have been deeply planed at the same time and that they are the same age. This is not possible in the process of peneplanation. It is possible in the process of pedimentation. The system operates precisely like the engineering method of open pit mining. A pit is opened to a given depth and enlarged by working back the walls. As soon as there is enough room,

a second level is begun -- the walls of both being worked back simultaneously. When the inner pit is large enough, a third is opened so that there results a series of terrace levels all being worked back at the same rate. As the wall above retreats a surface of planation is left behind to be consumed by the advancing wall below. Thus, although the levels represent earlier and later times of origin, the surfaces themselves have the same age.

Otherwise the "oldest" and highest surface of the Ozarks should long since have been destroyed while the youngest should be best preserved. In fact, the lowest and "youngest" surface, the Salem, is said to be the most dissected.(2)

It is accepted without equivocation that pedimentation is a process which occurs under arid conditions. It is equally true that stream entrenchment or dissection takes place under humid conditions.(6,7) The two processes are not compatible, and although there are no sharp breaks in climatic behaviour, which would lead one to assume the one type of topography should grade imperceptibly into the other, they do not do so. The controlling factor is not directly climate, but plant cover, and here the breaks are sharp and clear. In general, more than 20 inches of rainfall will produce forestation which is the most effective plant cover. Additional amounts of rainfall do not increase the effect. But, if rainfall is reduced below the amount necessary to support forest by as much as an inch or two, the forest cover is replaced by less effective grass, and a marked change in erosion rates follows.

It is therefore obvious that escarpments which are engendered by valley cutting are a product of the humid cycle which likewise furnished abundant moisture to nourish glaciation. It is equally clear that pedimentation is the product of the arid cycle which likewise starves the glaciers.

It is also to be remarked that multiple erosion surfaces can only be formed as a product of climatic alternation. There is no mechanism in the process of arid erosion to form scarps.

Finally, by the simple process of working backward, we can deductively assign ages to the origin of the surfaces and escarpments, relative to the humid glacial and arid interglacial stages of the

Pleistocene.

The youngest extensive land form is the V-shaped valleys cut into the borders of the plateaus. These are not now active. They must have been cut during the Wisconsin glacial stage (there is, however, little sign of terracing). The lowest extensive surface of planation was initiated during the Sangamon interglacial stage.

Minor alluviation	= Altithermal(1)	(Dry)
V-shaped valleys	= Wisconsin	(Wet)
Salem Plateau	= Sangamon	(Dry)
Eureka Springs Escarpment	= Illinoian	(Wet)
Springfield Plateau	= Yarmouth	(Dry)
Boston Mountain Escarpment	= Kansan	(Wet)
Boston Mountain Plateau	= Aftonian	(Dry)
Slopes of the Boston Mountain Buttes	= Nebraskan	(Wet)

Additional evidence for the Pleistocene age of the surfaces and the fact that diastrophism is not involved in their development, as would be necessary if they are partial peneplanes, is furnished by the physiography of the Arkansas River. The Arkansas flows between the Ouachita highland on the south and the Boston Mountains on the north. The highest point in the entire region is Mt. Magazine, with an elevation of 2,800 feet. Mt. Magazine is located in the valley 15 miles south of the river. It is approximately on a line trending northeast along the middle of the Ouachita-Ozark highland. This highland was formerly continuous (in pre-Pleistocene time) and the present Arkansas is the product of piracy of former drainage west of the highland. (Fig. 1) Streams on both the western and eastern flanks of the highland entrenched themselves and eroded headward until they met at the divide of the highland. Since the eastward flowing stream had a much lower base level and may be assumed to have received a greater amount of precipitation, and to have eroded its valley faster, the westward flowing stream came to be reversed, and the eastward flowing branch extended all the way across the highland. The Arkansas Valley nar-

PLATEAU SURFACES OF THE OZARKS

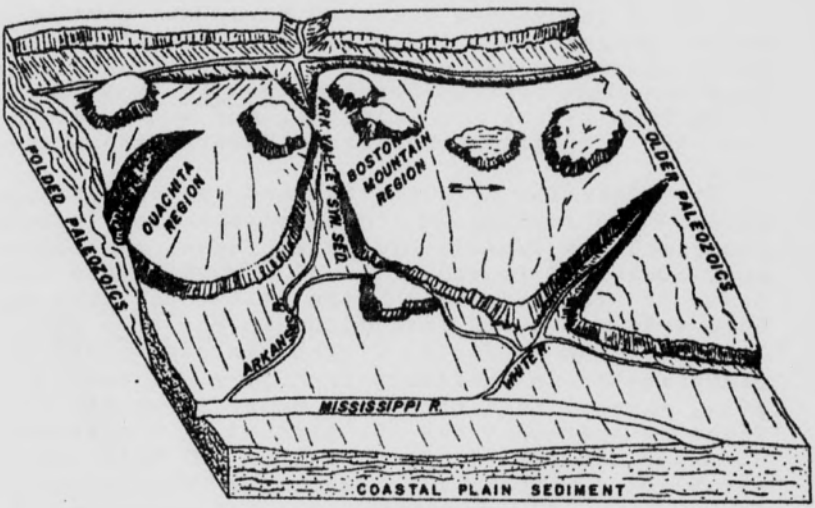


Figure 1

Schematic diagram of Ozark-Ouachita region indicating the gross drainage pattern in Kansan time before the Arkansas River had completed its headward erosion into the drainage system west of the highland. Sedimentary rocks of the Ouachita region are quartzites, slates and novaculite. Those of the Missouri Ozarks, chert, sandstone and massive limestones. These rocks may have retarded the headward encroachment of the Ouachita and White River. The Arkansas is entrenched in the softest rocks of the region, lower Pennsylvania sandstones, and shales mostly of post-Atokan (Pottsville) age. (R.A. Ault, University of Arkansas Graduate School, artist.)

rows in the vicinity of Mt. Magazine and widens progressively to both west and east. This fact together with the position and height of Mt. Magazine is otherwise difficult to explain. The highest surface, the Boston Mountain Plateau, seems to have extended across the valley region. Thus the highland must have been in essentially its present position and at, or higher than, its present elevation at the beginning of Pleistocene time. Development of the modern Arkansas River was completed before Sangamon time, since gravel terraces along the Arkansas, attributable to alluviation during Sangamon time, contain Permian Fusulinida which are found in northeastern Oklahoma, and were brought down the Verdigris and Arkansas Rivers into Arkansas.

The mechanism of planation and age assignments given here furnish the most reasonable, logical and simple explanation for the present physiography. Only one reevaluation of our cherished concepts is required, that in the past we can have had both arid and humid conditions in the same place. I would not go so far as King(5) in suggesting the peneplane is an imaginary land form. I would suggest, rather, that the great majority of the surfaces we see today are the product of Pleistocene climatic cycles. It follows that if this can be established, it may be possible to contribute a great deal of information to the patterns of Pleistocene climate, which will help us to a better understanding of the glacial mechanism.

LITERATURE CITED

(1) Antevs, E., 1952. Climatic history and the antiquity of man in California, Univ. Calif.. Archeol. Survey, No. 16, pp. 23-31.

(2) Croneis, C., 1930. Geology of the Arkansas Paleozoic area, Ark. Geol. Survey, Bul. 3.

(3) Davis, W. M., 1899. Physical Geography, Ginn and Co., Boston, Mass.

(4) Hershey, O., 1902. Boston Mountain physiography, Journal Geol. 10:160-165

(5) King, L. C., 1953. Canons of landscape evolution, Geol. Soc. Amer. Bul. No. 7, 64:721-751.

(6) Quinn, J. H., 1956. Origin and age of Ozark Plateau surfaces in Northwest Arkansas (abstract), Geol. Soc. Amer. Bul. No. 12, Pt. 2, 67:1726.

(7) Quinn, J. H., 1957. Paired river terraces and Pleistocene glaciation, J. Geol. No. 2, 65: 149-166.

(8) Purdue, A. H., 1901. Physiography of Boston Mountains, J. Geol. 9:341-342.

THE LIBRARY OF A REVOLUTIONARY LEADER, ANTONIO NARIÑO, PRECURSOR OF COLOMBIAN INDEPENDENCE

Thomas Blossom
Southern State College

Antonio Nariño, Precursor of Colombian Independence, 1760-1823, printer of The Rights of Man in Bogotá (1794), is an important transitional figure. Nearly seventeen years he spent in jails. Again and again he managed to escape to continue the fight for his supreme dream: a free, independent Republic of Colombia.

His victories (1812-1813), were tempered with defeat (Pasto, 11 May, 1814), his place in high offices alternated with long years in nine or more jails. His years of acclamation were followed by years of oblivion. His moments of happiness were sharpened by misfortune. Petty enemies dogged his footsteps to the bitter end. When he died in 1823, a few months after a famous speech on the Senate floor, he was still trying to guide the Republic of Colombia toward wisdom.

In some ways Nariño was typical of the group of wealthy, educated creole leaders who rose nearly to the top under Spain and became the top during the Revolution and the early days of independence.

Under Spain, he rose to the lucrative, honored posts of Royal Treasurer of Tithes and Royal Monopolizer of the Quinine Export of New Granada, owner of the official press and close friend of the Viceroy Ezpeleta. Under Colombia, Narino became President (1811), dictator, and General of Colombia (1813), and was briefly presiding Vice-President appointed by Bolivar in charge of the Congress of Cúcuta, (1821). Like most Colombian Presidents since then, he was owner and editor of a newspaper, (La Bagatela, July 14, 1811 -- April 12, 1812), through which he vaulted into the presidency. He was also the owner of a very large library which played a significant part in his early life in converting the wealthy creole from a royal official into a revolutionary republican leader. .

THE LIBRARY OF A REVOLUTIONARY LEADER

Through his library[1] Nariño acquired much of the learning of the eighteenth-century Enlightenment, a very critical attitude toward the Spanish empire, a burning desire to speed up the process of reform already under way in Spain's dominions, and an unbounded admiration for the United States and republican France. The vast number of Nariño's books on lists condemned by both the Roman Index and the Spanish Indice add further proof to a growing mass of evidence of two important facts: (1) Spanish censorship in 1794 was extremely weak; and (2) the books and ideas easily available to the wealthy creole and future revolutionary republican, Nariño, were extremely modern in every field of learning, including, among many others, such a wide variety as Montesquieu, Voltaire, Diderot, Mably, Raynal, Destutt de Tracy, the Koran, the Bible, Milton, Franklin, Linnaeus, and Buffon.

This library was truly "catholic" in that it was universal, heterodox, heretical, and hence "damnable" in the very literal sense as applied by the Inquisition. It is worthy of consideration for three reasons. First, the ideas contained in his library led Nariño into revolutionary thought and action, culminating in his printing the Rights of Man in 1793. Second, when no copies of the translation of the Rights of Man could be found, the discovery by the Inquisition of the physical existance of his library was used to prove his guilt. Third, the ideas contained in his books provided the source for his brilliant defense of himself which became so exasperating to his prosecutors that they not only condemned printed copies of it, but ordered them burned by the public hangman along with the book from which he had copied the Rights of Man.[2]

---

[1] Posada and Ibáñez, El Precursor, pp. 164 - 190. Documents listing properties and books of Nariño confiscated by court action between August 29, 1794, and September 3, 1794.

[2] Ibid., p. 621. Document contained in the November 25, 1799, report to Don Mariano Luis de Urquijo and the Council of the Indies by the Audiencia of Santa Fé relative to the case of Don Antonio Nariño and Don José Antonio Ricaurte.

When Nariño discovered that his printing of the Rights of Man would get him into trouble, he proceeded as soon as possible to hide all traces of his boldness. He was completely successful in destroying copies of the Rights of Man,[3] but in destroying his immense and valuable library of forbidden books, he was less thorough. His first step was to separate those works most likely to indicate the subversive nature of his republican and revolutionary sympathies. These books he placed in trunks and shipped out to his brother's place, "La Serrezuela."[4] In the middle of the night, his brother became frightened and, with the aid of a friendly priest named Gijon, transferred the books to an empty cell in the Capuchin monastery. There the spies of the Inquisition[5] located the books -- still damp from having been immersed in water somewhere -- and proceeded to identify the real owner, Antonio Nariño.[6]

In spite of missing title pages, the examiners began to identify some of the books, and to trace their provenance. Among the books in French were titles by such condemned authors as Jacques Necker, Montesquieu, William Robertson, Louis de Montalte, Voltaire, Diderot, d'Alembert, Raynal, Jean Berru-

---

[3] Ibid., p. 95.

[4] Ibid., pp. 152-154. The servant, Ildefonso Rico, on being questioned about the trunks he had helped to move, told his questioners that he had been informed that the trunks were heavy because they contained "unos quesos" -- some cheeses.

[5] Ibid., pp. 62, 146. See also José Toribio Medina, Historia del Tribunal del Santo Oficio de Cartagena de las Indias (Santiago, Chile, 1899), p. 387. (Hereinafter Medina, Historia del Tribunal.)

[6] Posada and Ibáñez, El Precursor, pp. 143 - 150. Document containing the report of Oidor Mosquera on hearings held September 13 and 14, 1794, in the Convent of the Capuchins, Santa Fé de Bogotá, and on September 20, 1794, in the courtroom of the audiencia and royal chancellery, Santa Fé de Bogotá.

yer,[7] Destutt de Tracy,[8] and Mably.[9] Rousseau was significantly missing, probably destroyed, for Nariño in his defense showed great familiarity with Rousseau and could quote passages verbatim from Foranda's version of the Social Contract.[10]

After the government investigators and the Inquisition[11] had listed seventy-eight[12] volumes of Nariño's choice collection of condemned books, they confiscated all of his properties and proceeded to draw up a list of books found in his home. This tremendous compilation of nearly two thousand volumes[13] included many anonymous and unknown au-

---

[7] Indice último de los libros prohibidos y mandados expurgar (Madrid, 1790), p. 291. (Hereinafter Indice ultimo.) Not all books in the Spanish Indice of 1790 are condemned in the Roman Index of 1786. Conversely, not all books in the Roman Index are condemned in the Spanish Indice. It should also be noted that while some authors, Voltaire for instance, were to be condemned for everything they wrote, others were placed on the list for only particular volumes. Many books were condemned "donec corregiatur" and new editions of the expurgated works could be approved. (Index Librorum Prohibitorum (Rome, 1786), pp. 185, 233, 219, 279, 88, 133, 134.)

[8] Indice ultimo, suplemento de 1805, p. 291.

[9] Ibid.

[10] J. R. Spell, Rousseau in the Spanish World before 1833 (Austin, Texas, 1938), p. 226.

[11] An Inquisitorial document from the Inquisition of Cartagena de las Indias, dated November 20, 1794, includes a receipt given to Luis de Mendoza, president of the royal audiencia in Santa Fé, for information on "the prohibited books belonging to Dan Antonio Nariño." Cf. Posada and Ibanez, El Precursor, pp. 157-158.

[12] Seventy-eight was the total named by the Inquisitors, but an actual count of their list indicates a total of eighty-five. (Ibid., 144, 147-150.)

[13] The Inquisition listed volumes found, the author (when known), and, in some cases a few descrip-

thors not specifically named either in the Spanish Indice[14] of 1790 or in the Roman Index of 1786.[15] Many of these, however, because of their anonymity or their heterodox character, were of such a nature as to be automatically suspect by reason of title or similarity to some of the most violently condemned works of the Enlightenment.[16]

Sermons in English by English "padres,"[17] dictionaries of "heresies,"[18] and titles concerning suspect or damnable words and phrases such as "Reason,"[19] "Nature,"[20] "Natural Law,[21] and "essential

---

tive phrases. (Ibid., pp. 164, 190.) Roland D. Hussey, "Traces of French Enlightenment in Colonial Hispanio America," in A. P. Whitaker, ed., Latin America and the Enlightenment (New York, 1942), p. 42.

E. Taylor Parks and Roberto Liévano claim Nariño had six thousand volumes in his library, but since they give no clue as to their method of obtaining this figure, it seems that the actual list of two thousand is more nearly accurate. (E. Taylor Parks, Colombia and the United States, 1765-1935 (Durham, N. C., 1935), p. 27. Roberto Liévano, Viejas estampas (Begotá, 1948), p. 8.)

[14] Indice ultimo.

[15] Index Librorum Prohibitorum.

[16] Anonymous books, called Class III, had been forbidden ever since the edict of 1559 of Paul IV and the Tridentine Index of 1564. (Indice ultimo, introduction, p. xii.)

[17] Many titles not included in the Madrid Indice of 1790 were nevertheless condemned in the New World by local edict, including English "sermons" as Dr. Dorothy Schons indicates in her Book Censorship in New Spain (Austin, Texas, 1950), p. lx, in which she disagrees with J. T. Medina.

[18] Posada and Ibanez, El Precursor, p. 167. Liguori was the author.

[19] Ibid., p. 172. French title, "Leve de la Raison."

[20] Ibid., pp. 186-187. Boyle's Introduction to Natural History and Almeida's Contemplation of Nature.

[21] Ibid., p. 176. Natural Law and Politica Natural.

order of Nature,"[22] apologies for Spain,[23] paraphrastic manuals, customs of the Israelites, Arabs and Turks,[24] to say nothing of the heretical English -- all these were found, in addition to better known condemned works of Mably, Milton, and Voltaire.[25] They were not of a type which would help Nariño get out of jail.

The case of Nariño's fight for Colombian liberty and the rights of man against Spanish monarchy, despotism, and intolerance (shown both in what he said[26] and in what his enemies said against him)[27] indicates that a last desperate effort was being made after 1789 to use the Inquisition and the Index to stem the tide of revolution set in motion by the Enlightenment. The Indice of 1790 made a hasty gesture to include in its appendices some of the more prominent works assumed to have been instrumental in stirring up revolution in France. In a similar fashion they might stir up revolution in Spanish America.[28]

There was also a considerable effort made to prevent printed copies of Nariño's defense from being distributed to restless, inflammable Latin Americans, because it was so thoroughly saturated with quotations from J. Carli,[29] Antonio Capmany,[30]

---

[22] Ibid., p. 173. By Antonio Pérez y López.

[23] Ibid., p. 176. By Juan Pablo Fornet.

[24] Ibid., pp. 169, 174. By Padre Ricardo Balsolobre and Felipe de Serf. One of these, Balsolobre's, was a manual of service for the dead, for those who do not believe in the doctrine of Original Sin.

[25] In the 1790 Indice, Milton is classed "I" (very damnable). See p. 182. All of Voltaire was condemned (p. 279) and even forbidden to Catholic scholars granted dispensation in order to refute heresy.

[26] Pérez Sarmiento, Proceso de Nariño, pp. 89-145.

[27] Ibid., pp. 33, 153.

[28] Ibid., p. 77. Nariño quotes Cayetano Filangieri, Ciencia de legislacion, which was condemned in the Indice ultimo, p. 295.

[29] Pérez Sarmiento, Proceso de Nariño, p. 113.

[30] Ibid., pp. 104, 117. Periodicals quoted by Nariño, pp. 100, 101, 113.

and many enlightened Madrid, Bogotá, and Lima periodicals. In fact, Nariño's judges in special secret session of the audiencia urged the home government to be on the lookout for printed copies of the defense, which they considered far more perniciously subversive of the empire than the works included in the appendices of the Indice, for the Precursor shrewdly quoted non-condemned books to support revolutionary ideas of the rights of man.[31] It was therefore necessary not only to shut up Nariño and his ideas in jail, along with his defense lawyer, Dr. José Ricaurte, but it was also vitally important to get the Inquisition and the Index to add their support to the collapsing Spanish empire as quickly as possible. This was accomplished.

In May of 1795, fifteen months after Nariño had burned the last copy of the Rights of Man, the Inquisition in Cartagena put his translation under ban by special edict.[32] The Cartagena Inquisition had already damned the original declaration in the year of its issue, 1789.[33] In order to plug other gaps uncovered by the defense, Nariño's prosecutors issued a special plea to condemn specifically, and in toto, two books which Nariño had often quoted in his defense: Capmany's Philosophy of Eloquence and Carli's American Letters. At the time the library had been confiscated, these books had been previously listed without comment.[34] Needless

[31] Ibid., pp. 80, 81-89.
[32] Ibid., pp. 39, 66.
[33] Ibid., pp. 33, 153. Cf. Medina Historia del Tribunal, p. 387. "Since the first ban of 1789 had no effect, Viceroy Ezpeleta sent out on September 5, 1794, a secret Oficio to the Cartagena Tribunal stating that the object of this printed work was to seduce simple and incautious persons with pretenses of favoring liberty of religion, and disturbing the good order and government established in the dominion of your majesty ... to which the Inquisitor, Marianna y Zafrilla, heartily agreed in a letter of September 22, 1794, and said he would do all in his power to find and destroy the damned, pernicious book."
[34] Perez Sarmiento, Proceso de Nariño, p. 28.

to say, Nariño's additional references to such commonly known condemned works as the Encyclopedia[35] tended to confirm the prosecutors in their belief that his quoting undamned books merely proved the old saying that the Devil himself could quote Scripture. Nariño they considered a devil and very "poisonous."[36]

An analysis of Nariño's shrewd defense makes it clear why his prosecutors considered ita more dangerous doctrine than the Rights of Man[37] and why it was to cost his lawyer, Ricaurte, a slow death by ten years of incarceration.[38] The principal argument throughout was that the ideas contained in the Rights of Man could be found in all sorts of

---

[35] Ibid., p. 77.

[36] Ibid., p. 81.

[37] Ibid., pp. 85-89. "La censura que merece esta detestable obra se presenta visible en su lectura." The four judges sitting in session on September 19, 1795, indicated their further annoyance with the accused Nariño by stating that he had the temerity to "condemn the cruelty of the conquistadores, calling them assassins. He said they enslaved the natives, oppressed them, tyrannized them, bled them with horrible taxes like the alcabala . . . whereas it is well known that the proper attitude of loyal subjects is blind obedience to our superiors, the only fitting attitude for your majesty's subjects."

[38] Gonzalo Bulnes, Nacimiento de las repúblicas americanas (2 vols., Buenos Aires, 1927), I, 13, misleads the reader by stating that Ricaurte was freed by royal clemency in 1804 after having been jailed at the time of Nariño's return in April, 1797. Technically, this statement is true. However, it is misleading inasmuch as the prisoner died before the order to release him arrived in Cartagena. Ricaurte was not jailed originally because of any crime for which he had been tried and sentenced, but because of the "general principle" that his ideas were subversive. (Pérez Sarmiento, Proceso de Nariño, pp. 66-73.)

acceptable books and magazines circulating both in Spain and in the colonies.[39] His brief is so shrewdly planned and so clearly indicative of an amazing mastery of the main ideas of the Enlightenment gleaned from his vast library, that it is worthwhile to follow Nariño and the thread of his argument in some detail. If proof were needed that the same Enlightenment which bred "Philosopher Princes" also bred "Revolutionary Republicans," we would scarcely find better evidence than in Narino's defense. For example:

> . . . in El Periodico de Santa Fé, which circulated widely in the hands of the people, one can read horrible sketches concerning the present French Revolution, and, reasoning as my accusers do . . . one could thus become an enthusiastic libertine . . . . Or take the GAZETAS of Spain and do the same . . . . If one can be so easily corrupted by reading about the actions of the National Assembly of France, it would be like saying one could be seduced from the truths of our HOLY RELIGION by the stupid expressions in the Koran . . . . or take EL ESPIRITU DE LOS MEJORES DIARIOS[40] published in Madrid, found here everywhere in the hands of children and women . . . approved by our monarchs who were initial subscribers to it as were also the Chief Ministers of the nation, and in Diary Number 156, Page 615, we find "MAN IS BORN FREE . . . . as soon as he reaches maturity and reason, he is entitled to choose his country, and entitled to choose the govern-

---

[39] Pérez Sarmiento, Proceso de Nariño, p. 99.

[40] Spell, op. cit., pp. 115, 144, indicates that Floridablanca, a frightened liberal in 1792, had already reversed himself and quickly suppressed the Espiritú, which he had originally so eagerly sponsored a scant three years previously. Nariño was therefore treading on very sore toes.

> ment which best suits him and his ideas.... If he has sacrificed a part of his liberty to government, it is to better his lot, and the most important truth to remember is that the rights of property, liberty, and security are the strongest supports of the well-being of all states . . . . The monarch has no right to disregard the laws in a fit of anger, superstition or tyranny.[41]

Words like those just quoted must have exasperated the viceroy and Nariño's accusers, for they all had been educated in the intellectual climate of the Enlightenment and had subscribed with enthusiasm to its revolutionary ideas only a few years or months before Narino's arrest. To prove this true, and that some of them had committed their ideas to print, Nariño quoted from the 1785 doctoral dissertation of one of his prosecutors, Fiscal Manuel Blaya.[42] This dissertation, entitled "Means of Promoting More Marriages and of Increasing the Population of Europe," had as its main thesis that men would not willingly marry and beget children when they knew their children would inherit a miserable life of slavery in the unreformed, tyrannical, despotic, and irrational monarchies of that day (1785). Such shrewd proof that his enemies had earlier subscribed to the then praiseworthy liberal, but now subversive doctrines of the Enlightenment, was hardly calculated to win friends for Nariño, but does not seem to have deterred him from his daring, though, foolhardy, course.

---

[41] Perez Sarmiento, Proceso de Nariño; pp. 100,101.

[42] Ibid., pp. 76-80. Documento Number 26 in the Proceso seems to have called forth an explanation from Blaya who plaintively hastened to justify his dissertation as the "indiscretions of a young law student at the Academy of Saint Barbara." (p. 76.) He seems to have been alternately angered, annoyed, and worried at his youthful peccadillo, and stated that he thought allowance should be made for the dissertation as the work of a "muchacho que estava entonces aprendiendo." (p. 77.)

He went right on embarrassing the erstwhile liberals. Quoting from number 155 of the Espiritú de los mejores diários, he says:

> The Creator of the world, having made all men equal, it is to their own interests to consult and realize their mutual happiness as individuals of one family, however much they may differ in color and in other things of little import, not essential and founded on whims of chance. Persons who profess to maintain for their own good the Rights of Mankind and of all living persons subject to the obligations of Christianity, must neglect nothing to help all to enjoy the delights of liberty and in particular to aid our fellow beings who have a right to them by the laws and Constitution of the United States, and who now chafe in irons of the most severe slavery.... Firmly convinced of the truth of these principles, animated with the desire to spread them to all parts of the world wherever the calamities of oppression reign, and filled with the greatest confidence in the favor and protection of the Universal Father, the subscribers of this society have joined together in Philadelphia to promote the abolition of slavery.[43]

Even when found imbedded in accepted Spanish periodicals, sponsored by the king himself, such subversive ideas as Nariño quoted were scarcely apt to be palatable to a harassed Spanish viceroy, even one reputedly liberal, like Ezpeleta. No more acceptable were similar ideas from the expurgated edition of the international legist Heineccius[44]

---

[43] Ibid., pp. 102-103.

[44] Indice ultimo, p. 120. Hugo Grotius, the "Father of International Law," was condemned by name and all his works were condemned specifically by title. It is therefore not surprising to find that some lesser known commentator like Heineccius was similarly suspect. The Roman Index of 1786 lists and condemns by title seven

concerning the "Natural Equality of Man," or, for that matter, Saint Thomas Aquinas. Any partially expurgated work like Heineccius was automatically suspect and even in far-away Bogotá it must have been common knowledge that the Encyclopedia was almost as damnable and devilish as Voltaire. Such publications were relisted clearly and condemned in toto in the new Indice of 1790.[45] Since Aquinas is not condemned, it was an unforgivable trick for Nariño to quote passages and phrases from the Angelic Doctor similar to those of Voltaire and Diderot.

As for Antonio Capmany's Philosophy of Eloquence, it was considered so subversive, and angered Nariño's judges to such an extent that they secretly requested that the Inquisition issue a special edict condemning it and Carli.[46] Yet this work was also quoted by Nariño to support his main thesis that revolutionary republican ideas like those of the Rights of Man were to be found everywhere in acceptable books read by every educated person. A few passages will suffice to indicate the tone of Capmany: "No man has received from nature the right to command any other; liberty is the gift of heaven and each man has the right to enjoy it starting from the moment when he can use reason." In a similar vein Nariño quotes: "It seems also according to Heineccius that the power of kings eminates from the people and Heineccius is the legist we are ordered to follow in our schools."[47]

In order to estimate the full exasperation of Nariño's judges, who, like Blaya, found their own words quoted to show that they had once thought and written like the accused, it is well to remember that events in France, from 1789 to 1794, had aroused fear and a rapid retreat from liberalism and from reform in Spain. The small but influential clique of liberals who had joined Aranda after

---

works of Grotius (p. 127) and all of the works of Pufendorf (p. 235).

[45] Indice ultimo, pp. 9, 248. (Aeneas Seneca was also condemned by name and in toto.

[46] Pérez Sarmiento, Proceso de Nariño, p. 28.

[47] Ibid., pp. 104-105.

1765 in the formation of the Royal Basque Society of Friends of the Country[48] found themselves in disagreement as to how far they should retreat from their old liberalism and reformist plans in these hectic years. The Basque reformers who had so recently succeeded in ousting the powerful organization of that earlier Basque reformer, Ignatius Loyola, in 1767, found themselves now called on to revive the Inquisition which Aranda had once boasted he would have ousted along with the Jesuits except for his indiscretion in mentioning his hopes to Voltaire.[49] By the time Nariño was quoting from books and periodicals once sponsored by the crown itself for a third of a century, the Basque Society clique had been replaced by Godoy.[50] Aranda's brief return to power in 1792 lasted less than a year and was followed by such a complete overthrow of the reformers that Aranda himself was persecuted by the revived Inquisition whose plans for thorough revenge were only foiled by Aranda's sudden death.[51] Nariño's defense, therefore, fell on the unsympa-

---

[48] Jose Torre Revello, El Periodismo en America durante la dominacion espanola (Buenos Aires, 1940), p. 172. This work gives some valuable information on the Basque Society which bears directly on Nariño. He states that the first one, founded by Aranda and his friends in Madrid, was modelled on a similar British Economic Society. There were soon seventy branches in Spain and the colonies, that the first one in Colombia met at Mompos from September 12, 1784, to December 19, 1784. Their proceedings were printed by the royal printer Expinosa de Monteros. Espinosa was Nariño's printer of the Rights of Man.

[49] Spell, op. cit., p. 49.

[50] Ibid., p. 144. Spell quotes Godoy's own admission that the reformers were forced into hiding and all periodicals except the Gazeta eliminated. The Gazeta was allowed to speak "less of France than if it had been China." (C. E. Chapman, History of Spain (New York, 1927), pp. 228, 432.)

[51] Spell, op. cit., pp. 51, 144.

thetic ears of the new Godoy ministry. Almost every book and periodical quoted by Nariño was condemned in the new wave of censorship and this was especially true of the Espiritú de los mejores diarios,[52] so often quoted by Nariño in his defensa.

Nariño's possession of books[53] on how to organize a Basque model reform society would therefore constitute prima facie evidence of his interest in the newly unseated, dispossessed, suspect liberals. Though only recently and briefly reseated in the person of Aranda, by mid-1794 their popularity[54] and power had been rapidly reversed, and following Aranda's fall they were immediately persecuted as subversives, traitors, and revolutionaries.[55] Menéndez y Pelayo probably represents rather accurately the spirit of reaction when he damns the Aranda liberals for favoring such accursed heretical ideas as civil marriage, public education, and religious toleration. And, of course, he damns them for weakness and treason in the face of the French advance

---

[52] Posada and Ibáñez, El Precursor, p. 632.

[53] Ibid., pp. 174, 176. The titles of the books were Ensayo de la Sociedad Vascongada de los Amigos del Pais and Estatuto para gobierno de la Real Sociedad Vascongada.

[54] Rafael Altamira, A History of Spain from the Beginnings to the Present Day, trans. by Muna Lee (New York, 1949), pp. 513-514, attributes the meteoric rise and fall of Aranda in 1793 to the queen who put him in only long enough to force Godoy to pay less attention to another woman and more to her. French pressure was a secondary influence.

[55] Antonio Ballesteros y Beretta, Historia de España y su influencia en la historia universal (9 vols., Barcelona, 1918-1941), V, 251-253, 257. This work states that Aranda was removed for vacillating and for failing to adopt a tough policy toward France that he was exiled to Jaen and finally jailed in the Granadine prison of the Alhambra for urging Godoy to make peace with France and for criticizing Godoy's failure in foreign affairs.

of 1794.[56] There is probably a certain amount of truth in his charge that sympathy with French ideas weakened the Spanish will to resist French armies. There is also reasonable ground to believe the accuracy of his claim that the economic societies, hastily abolished by the ex-liberal, Floridablanca, in 1791-1793, had rapidly converted themselves into "Patriotic Societies of French Style"[57] when they went underground. Nariño, like Aranda, was thus caught in the reversed tide of conservative reaction set in motion by the excesses of the French Revolution in 1793. There seems good reason, therefore, to claim that the excesses of the French Revolution set back the cause of moderate reform and progress not half a century, as in England,[58] but until the present day.[59]

The events of 1789-1794 which threw Spain into a nightmare of revolution and counter-revolution were not likely to prove annoying or threatening to her greedy neighbors. The greatest empire in the world was now a plum ripe for the picking. As long as anything was to be gained by keeping Spain weak, neither England, France, nor the United States would be eager to end the chaos of revolutions in the Americas, or in Spain. Even in 1794, Spain still held the largest empire in the world. If Spain became another Poland, no one but Spain would care -- least of all American Spaniards like Nariño who dreamed of independence. England, France, and the United States all offered to aid the cause of Colombian independence for different, selfish and often conflicting reasons. From each Nariño hoped to borrow aims and ideas, but always it was independence he sought.

---

[56] Marcelino Menéndez y Pelayo, Historia de los heterodoxos españoles (2nd ed., 7 vols., Madrid, 1911-1932), VI (1930), 270.

[57] Ibid., p. 296.

[58] W. T. Laprade, England and the French Revolution, 1789-1797 (Baltimore, 1909), passim.

[59] Joseph McCabe, Spain in Revolt, 1814-1931 (New York, 1932). This author was overly optimistic when he thought this period of violent revolution and counter-revolution had ended in 1931 with a moderate constitutional republic.

THE LIBRARY OF A REVOLUTIONARY LEADER

If there is any one model or hero whom Nariño admired more than any other, it was not a Frenchman, but an American, Benjamin Franklin. Before we consider the failure of his defensa, his escape from the prison ship in Cádiz harbor, and his amazing Odyssey back to Bogotá via Madrid, Paris, London, Bordeaux, and Venezuela, it might be of value to summarize the Franklin influence on him. Besides his knowledge of the new scientists --Condillac, Linnaeus, Buffon, and those who established the scientific spirit and method, Galileo, Newton and Descartes -- Nariño had a library[60] and laboratory equipped for experiments in electricity a la Franklin. In his "Santuario" he had a bust of Franklin and a motto on a scroll which read, "He snatched the lightning from the skies and the sceptre from the tyrant's hand." In his defense peroration, Nariño closed with the fervid hope that the land of reason, liberty, and toleration, the land of Franklin, Washington, Hancock, and the Adamses would never die.[61]

The audiencia in Bogotá found him guilty on November 28, 1795, of sedition, treason, and attempted overthrow of the government. It ordered the Rights of Man, from which he copied, to be burned by the hangman in the principal square of Bogotá, his property confiscated, and sentenced him to exile and confinement, preferably to the rockpile of a North African presidio.[62]

From that day forward, Nariño's life was one of jailings, escapes, recaptures, plots toward independence and finally of military campaigns for Colombian independence. By the time of his death in 1823, Nariño was the grand old man of Colombian independence, second only to Santander in Colombian politics, and still famous as the Precursor, whose library, ideas and printing of the Rights of Man had started Colombia toward revolution and Independence in 1794.

---

[60] Posada and Ibáñez, El Precursor, pp. 164-186. Over a hundred volumes in Nariño's libraries are recognizable as scientific and include such fields as medicine, botany, chemistry, physics, surgery, mathematics, and electricity.

[61] Ibid., p. 80. [62] Ibid., p. 620.

A SIMPLE THERMISTOR BRIDGE FOR ABSORBED RADIATION MEASUREMENT

Jack G. Dodd
Drury College

GENERAL

An investigation currently under way of the quantum efficiency of photolysis of sodium azide necessitated accurate measurement of absorbed radiation in the ultraviolet region of the spectrum. Since our small grating monochromotor coupled with a carbon arc source delivered less than a hundred microwatts at the output slit, and since only a fraction of this energy may be absorbed by the sample, any radiation detector used must be very sensitive. Simple thermocouples were out of the question, and thermopiles which could double as sample-holders were very inconvenient to manufacture, besides being very fragile.

For these reasons some sort of bolometric technique was indicated. The characteristics of thermistors made them admirably suited for this sort of use.(1,2)

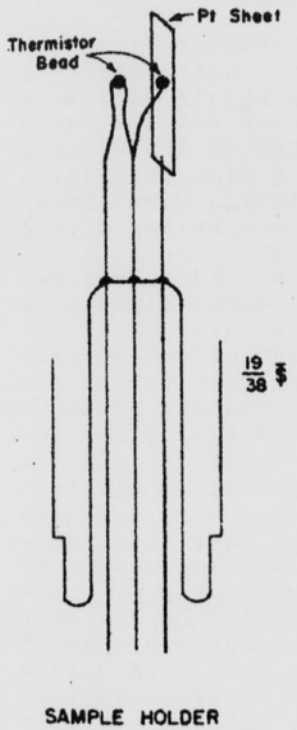
DESIGN AND PERFORMANCE OF THE PHOTOLYSIS CELL

Since the measurement of the rate of photolysis of the inorganic azides was to be accomplished by measuring the rate of evolution of nitrogen by means of the change in pressure in a continuously pumped evacuated enclosure, the unit was constructed of glass with a cemented quartz window through which the monochromator beam was to pass. The arrangement is shown in Figure 1.

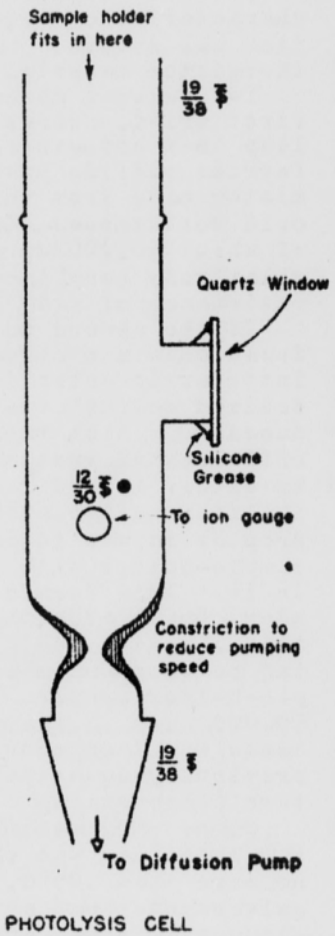
The sample-holder consisted of a piece of 1-mil platinum foil about 4 x 20 mm spot - welded to a tungsten lead sealed into a 19/38 standard taper. Two other tungsten leads which serve as the other two leads of the thermistor bridge were also sealed into the taper as shown in the drawing.

The platinum sample-holder served as one lead of the sensitive bridge thermistor. The other lead of the sample-holder thermistor was common to the balancing thermistor which was connected between

A SIMPLE THERMISTOR BRIDGE



SAMPLE HOLDER



PHOTOLYSIS CELL

Figure 1.

the other two tungsten leads sealed into the taper. The second thermistor was positioned so that it was shadowed from the incident light by the sample-holder and thus did not change temperature during irradiation (see Figure 2).

Because thermistors of the special physical characteristics required were not available, some time was devoted to the development of suitable thermistor materials.(3)

Two general methods were found suitable: In the first tried, a borax bead was fused onto a nichrome loop in a hot gas flame and alternately dipped in ferrous sulfide powder and re-fused until a thermistor made from this material showed the desired cold resistance. In this case, a cold resistance of about 50,000 ohms was used, although it was found relatively easy to make thermistors having a cold resistance of from 25 ohms up.

In the second method, a bead of soft glass was fused onto a nichrome loop and alternately dipped into ferric chloride and re-fused until it had the desired characteristics. This second method produced the best thermistors. The temperature coefficient of resistivity of thermistors produced by either method ranged from -.02 to -.03 per °C.

After suitable thermistor material was made, a drop of it was fused onto the back of a platinum sample-holder with a fine platinum wire imbedded in it. This formed the radiation sensitive junction. Small adjustments in the cold resistance of this junction could be effected by varying the spacing between the imbedded platinum wire and the sample-holder proper. This value was adjusted to about 50,000 ohms. A thermistor of the same cold resistance was then mounted behind the sample-holder as previously described to form the ambient temperature compensating element of the bridge.

Since the maximum temperature change of the sample-holder was expected from calculation to be no more than .05°C, and since no highly sensitive galvanometer was available for use as a null instrument, it was anticipated that the bridge output would have to be amplified to be useable. A simple d.c. amplifier was therefore constructed. A schematic diagram of the instrument is shown in Figure 2. It had a voltage gain of about 16, and an output impedance of about 200 ohms.

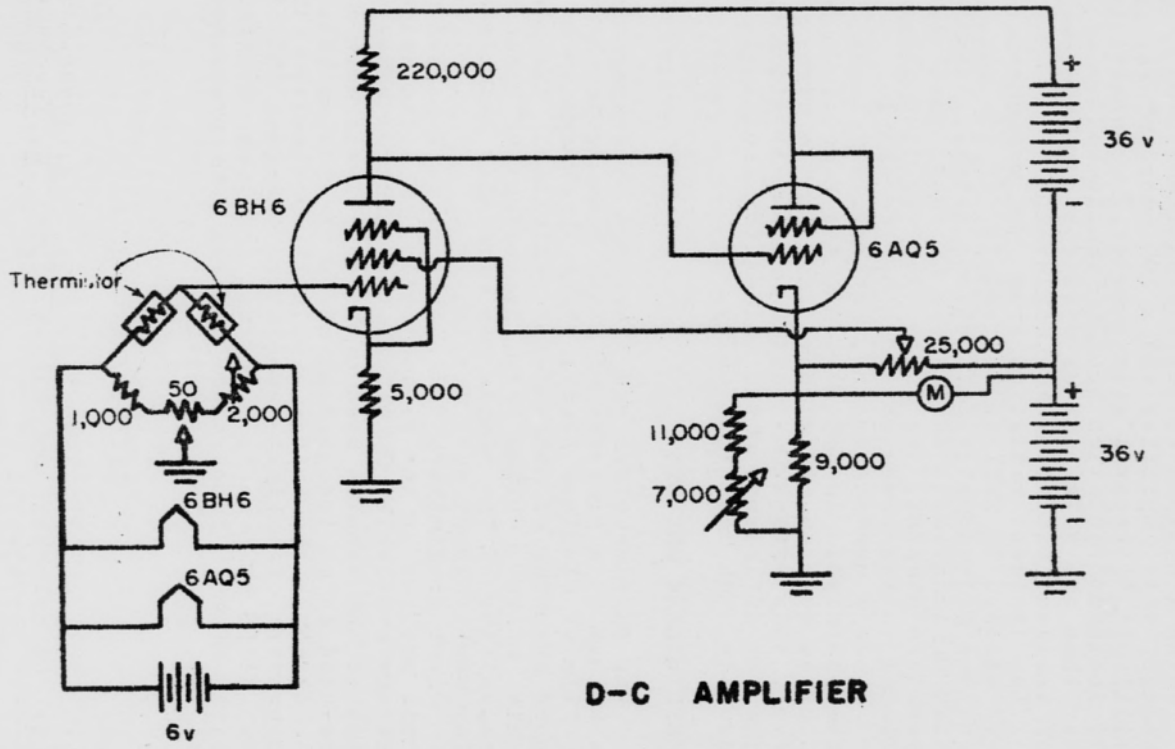

220,000
6 BH 6
6AQ5
Thermistor
36 v
25,000
M
5,000
50
1,000
2,000
11,000
9,000
7,000
36v
6BH6
6AQ5
6v
D-C AMPLIFIER

Figure 2.

Using a helipot as the two external arms of the bridge, this amplifier and a 100 microampere, 100 millivolt D'Arsonval galvanometer, a sensitivity to incident radiation upon the sample-holder of better than one galvanometer division per microwatt of incident radiation was achieved.

The incident radiation from the monochromator was allowed to fall on the sample for one minute, and the galvanometer deflections noted. Assuming that the instrument was linear for these small temperature changes, the deflection was then proportional to the power absorbed by the sample.

Since a certain amount of energy is released by the photolytic decomposition of the sample, the indicated quantum efficiency should be too high; however, this effect is expected to be small since the quantum efficiency of the azides for photolysis is usually much less than unity.

PRELIMINARY RESULTS

The sample-holder was blackened by evaporating aluminum at a pressure of about 5 mm Hg to obtain a film of aluminum black, which is known to be a good absorber of ultraviolet radiation. Assuming this to be a black body, the effective spectral emissivity of the sample may be readily calculated for any incident wave length.

Since preliminary data taken by F. Koperski of this project on the reflectivity of solid azides is now available, the calculated spectral emissivity of the samples used in the photolysis work can be used as an independent check on this method.

Although the bridge should theoretically be independent of ambient temperature changes, this is not found to be so in practice, and lack of effective ambient temperature control has prevented, so far, the taking of data.

LITERATURE CITED

(1) Prigent, J., 1949. J. Phys. Rad. 10:58-64.
(2) Fuchslocher and Glazer. 1954. Z. fur Phys. 38:363-371.
(3) Zwikker, 1954. "Physical Properties of Solid Materials," Pergamon Press (London), p. 224.

THE RELATIONSHIP BETWEEN A TIME SCORE AND ANXIETY SCORE ON THE TAYLOR ANXIETY SCALE

Donald H. Kausler and E. Philip Trapp
University of Arkansas

Since Taylor(6) derived her anxiety questionnaire as a quantitative method for measuring relative drive level among human subjects, a number of studies (e.g., 4,5, 7) have appeared employing her questionnaire as a criterion measure of drive level. These studies have characteristically used the questionnaire in the testing of some hypothesis relative to drive and learning.

In addition, there have been many reported studies on the questionnaire per se (e.g., 2, 3, 6). They have focused chiefly on the problem of reliability, validity (as measured by correlation with other indices of anxiety), and the relationship of anxiety level to other independent attributes (such as intelligence). As part of a broader study involving the questionnaire, the writers took the opportunity to investigate a performance factor other than item selection or test score. The variable examined was the time required to complete the questionnaire. The study was concerned with investigating the relationship of this variable to the quantitative score on the anxiety questionnaire.

Thus, this research should be viewed as a pilot study, mainly to tap the feasibility of using a more refined time measure in future experimental work.

METHOD

Eighty-six students, approximately the same number of each sex, in two sections of an undergraduate course in abnormal psychology at the University of Arkansas were given the short form of the Taylor Biographical Inventory. The subjects were told that the purpose of the questionnaire was to collect and compare biographical information among typical college students in different sections of the country, and that they were part of the sample drawn from the south-central sector. The specific instructions for the questionnaire followed very closely those outlined by Taylor and were as follows:

The statements in this test booklet represent experiences, ways of doing things, or beliefs or preferences that are true of some people but are not true of others. You are to read each statement and decide whether or not it is true with respect to yourself. If it is true or mostly true, mark a plus sign on the answer sheet. If the statement is not usually true or not true at all, mark a zero sign on the answer sheet. Answer the statement as carefully and honestly as you can. There are no correct or wrong answers; we are interested in the way you work and in the things you believe. Are there any questions?

As the answer sheets were returned to the administrator (the subjects were told to return the answer sheets as soon as they were finished), they were given a rank based on the order of completion. That is, the first answer sheet returned was given rank one, the second, rank two, etc. Time of completion ranged from approximately five to thirty minutes.

There are 90 items on the questionnaire of which 50 are keyed as anxiety responses. An individual's score is the total number of keyed items answered by the individual in the direction indicated by the key. The underlying hypothesis of the questionnaire is that high scores are indicative of high anxiety drive; low scores are indicative of low anxiety drive.

RESULTS AND DISCUSSION

The subjects were divided into four quartiles based upon the order of return answer sheets. The first quartile (Q_1) consisted of the first 22 subjects to complete the questionnaire; the second quartile (Q_2) consisted of the next 21 subjects; the third quartile (Q_3) of the next 21 subjects; the fourth quartile (Q_4) consisted of the last 22 subjects to complete the questionnaire.

For each quartile the mean and standard deviation of the total anxiety scores were determined. These means and standard deviations are as follows: For Q_1 the mean is 16.18 and standard deviation is 7.90. For Q_2 the corresponding values are 13.62 and 6.34. For Q_3 they are 14.86 and 7.44. For Q_4 they are 16.95 and 6.12.

Following the procedure given by Edwards(1), a simple analysis of variance was performed to test the significance of differences between means for the four quartiles. This analysis yielded an F of .99 which is not significantly beyond chance expectancy.

The nature of the quartile means, however, suggested that the first and fourth quartiles combined represent a different population of anxious subjects than do the second and third quartiles combined. Consequently, the anxiety scores for the first and fourth quartiles (N=44) were pooled together, as were the anxiety scores for the second and third quartiles (N=42). For the first and fourth quartiles the mean is 16.57 and standard deviation is 7.90. For the second and third quartiles the mean is 14.24 and the standard deviation is 6.94. A t test was made of the difference between means, where t = Mean 1 - Mean 2/Standard Error of Difference. The obtained t of 1.52 ($p < .13$) does not permit us to reject the null hypothesis (no real differences between means) at the .05 level of confidence, but does suggest a trend worthy of further investigation with a more refined methodology.

From this exploratory study the hypothesis is offered that high anxiety drive subjects form two extreme groups in their performance on the Taylor anxiety questionnaire. They tend to complete the questionnaire very rapidly; that is, test time is short, or they tend to require considerable time to complete the questionnaire; that is, test time is long. Low anxiety drive subjects are more likely to take intermediate durations of time to complete the questionnaire. This hypothesis follows also from the nature of anxiety itself and its differential effects upon human behavior. It may be expected that high anxiety drive subjects, possibly the controlled type, might speed through the questionnaire as an escape technique to an anxiety provoking situation. Other high anxiety drive subjects, possibly the free-floating type, may experience more directly their anxiety and have difficulty completing an anxiety provoking task.

To adequately test this hypothesis a more rigorous procedure for measuring time score should be used. An individual administration of the questionnaire would be desirable. This would permit

a precise measure of the time taken by a subject to complete the questionnaire.

LITERATURE CITED

(1) Edwards, A. L., 1950. Experimental design in psychological research. New York: Rinehart.

(2) Hoyt, D. P. and T. M. Magoon. 1954. A validation study of the Taylor Manifest Anxiety Scale. J. Clin. Psychol. 10:357-361.

(3) Kendall, E., 1954. The validity of Taylor's Manifest Anxiety Scale. J. Consult Psychol. 18:429-432.

(4) Spence, K. W. and I. E. Farber. 1953. Conditioning and extinction as a function of anxiety. J. Exp. Psychol. 45:116-119.

(5) Spence, K. W., I. E. Farber and H. H. McFann. 1956. The relation of anxiety (drive) level to performance in competitional and non-competitional paired associates learning. J. Exp. Psychol. 52:296-305.

(6) Taylor, Janet. 1953. A personality scale of manifest anxiety. J. Abnorm. Soc. Psychol. 48:285-290.

(7) Taylor, Janet and K. W. Spence. 1952. The relationship of anxiety level to performance in serial learning. J. Exp. Psychol. 44: 61-64.

INSTRUCTIONS FOR CONTRIBUTORS TO THE PROCEEDINGS

All members who present papers at regular meetings of the Academy are eligible to submit their papers for publication in the Proceedings. The Editorial Board will be glad to consider all manuscripts submitted, but reserves the right to edit, shorten, or reject any papers which, for any reason, are judged by the Board either not appropriate or not within the scope of the activity of the Academy. When any question arises with the Board itself, papers will be referred to specialists in the proper fields.

Manuscripts should be clearly typewritten, double-spaced throughout, with a margin of at least one inch on each side.

Title should be followed by author's name and location, including firm, school or other connection, and city.

Explanatory footnotes should be set into the manuscript following the passage to which they refer, but separated from the text by a line above and below the note.

Abbreviations should follow leading journals in the particular field covered by the paper.

Literature cited should be listed at the end in alphabetical order by authors, and numbered consecutively. Reference in the text then will be by these numbers placed in parentheses at the point of reference in the text. For example:

1. Bailey, I.W. 1949. Origin of the Angiosperms. Jour. Arnold Arboretum 30:64-70.
2. Colomb, M.G. 1887. Recherches sur les stipules. Ann. Sci. Nat. Bot. 6:1-76.
3. Holm, T. 1890. Notes on the leaves of Liriodendron. Proc. U.S. National Mus. 13:15-35.
4. Welch, Paul S. 1935. Limnology, p. 85. McGraw-Hill. N.Y.

Acknowledgments may be put in as a footnote to the title.

Tables and/or charts should be on separate sheets and their position in the text clearly indicated. Suitable explanation should accompany each table or chart even when further explained in the text.

A suitable summary, wherever appropriate should follow the text.

Illustrations may be used, but line drawings are more easily reproduced than photographs and should be used wherever possible. Line drawings should be of appropriate proportions as to fit within the space allowed for the text of this journal. Photographs require special handling and will be charged to the author at cost. If several drawings or figures are used, they should be grouped as conveniently as possible and numbered consecutively.

Reprints. Orders for reprints should be sent to the Managing Editor along with corrected proof.